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ART. XXI.—*Notice of the Narrative of the U. S. Expedition to the River Jordan and the Dead Sea*, by W. F. LYNCH, U. S. N., Commander of the Expedition; with Maps and numerous illustrations.

THE Dead Sea so remarkable in sacred history and full of mysteries both to the popular and scientific mind, has at last been successfully explored. Its headlands have been mapped out, its bottom has felt the sounding lead, and boats from a country unknown to the ancient world have ploughed its sullen waters. Lieutenant Lynch, to whom the Expedition was intrusted by Government, in 1847 took command of the store ship Supply; and was provided for his explorations with two metallic boats—one of copper and the other of galvanized iron. Ten vigorous young American seamen "pledged to total abstinence" were enlisted as a crew for the boats; and to their temperance was attributed their recovery from the extreme prostration consequent on this hazardous service. Lieutenant Dale, an officer of high attainments and abilities, was associated with the commander: and it was with deep grief that we heard the announcement of his death soon after the explorations were completed: he was like Molyneux and Cortigan before him, a victim to the deadly influences that still hover over the old "cities of the plain."

They sailed from New York, Nov. 26, 1847, and landed at Beirut on the 25th of March following. On the 28th they left for St. Jean d'Acre, and took their departure for the lake of Gennesareth, from the river Belus. Their boats, which were made in sections for transportation, were placed on trucks brought for

the purpose, and drawn by camels. The party numbered sixteen besides fifteen Bedawins, all well mounted. On the 6th of April they obtained the first view of the Sea of Galilee and the majestic mountains of Bashan beyond; "like a mirror it lay embosomed amid its rounded and beautiful, but treeless hills." It measures seventeen miles long by six broad, and is situated twenty-eight miles east of Acre, and forty-five north of Jerusalem. The depth was found to be 165 feet where greatest, and the hills around were 600 to 700 feet high. Its waters are sweet and transparent, and as of old, fishermen here throw their nets with success. The Jordan flowing from Lake Merom far to the north, passes through this sea and continues on south. The party reached Tiberias, "a walled town of some magnitude, but now in ruins from the earthquake of 1837 which destroyed many of its inhabitants." Near by they visited two baths, in one of which—about eighteen feet across and four feet deep—the water stood at 143° F.: it was saline and bitter, and gave off an odor of sulphuretted hydrogen. They rowed along the shores of the lake to the exit of the Jordan.

The divisions of service now introduced, were as follows:—First, a party by land, keeping as near to the river as possible; next, a party in the boats—the former with the camels, Arabs, &c., led by Lieut. Dale—the latter by Lieut. Lynch. Dr. Anderson was charged with the geology; Mr. Bedlow with the topography, scenery and events; Mr. Francis Lynch with the herbarium; Lieut. Lynch with the river and its productions; Mr. Aulick with its topography and a sketch of the river and its shores. A signal of two guns in quick succession from the boats was agreed upon to summon assistance from the land party in case of an attack on the boats, which was the danger most to be feared.

On the 10th of April they entered the river. The Bedawins, —thirty horsemen with their abas flying in the wind,—were armed with guns in European style. Eleven camels led the way; then followed the cavalry and all in single file, while Lieut. Dale and his officers in the Frank costume, brought up the rear, the whole making an imposing cavalcade. The scenery on leaving the lake was not particularly grand; there were abundance of flowers but no trees. The average breadth of the Jordan at this place was about seventy-five feet; the water was ten feet deep and clear, and where the current was strong they used the oars, only to keep them in the channel. Many wild fowl were frightened from their feeding grounds in the marshes as they descended.

They passed the ruins of the bridge of Semakh which were extremely picturesque, the abutments standing in various stages of decay, and the falling fragments obstructing the course of the river, save where the water runs in a sluice among the masses of stone.

The Jordan is full of rapids, some of which are extremely dangerous, and the boats shot down one after another with no small peril. The river during the day was twenty-five to thirty yards wide, current two and a half knots, water clear and sweet. No rocks cropped out on the banks, but large boulders of sandstone and trap were scattered over the surface. The land on which the party encamped is held upon condition that the Sheikh shall entertain all travellers with a supper, and barley for their horses, and they partook on this occasion of an entire sheep and buckets of rice.

The second day (April 11), the current at first was about two and a half knots, but soon became a foaming rapid, and below were five successive falls of about eighteen feet in all, with intervening rapids. With much labor and no small difficulty the boats were passed safely down, having been previously unloaded; the men plunged into the water to guide them, and ropes with grapnels were also used to let them down stern first in some places. Fishes were often seen in the transparent water, and white storks, ducks, and a multitude of other birds rose from the reeds and osiers or plunged into the thickets of oleander and tamarisks which line the banks.

On April 12, they were about three hours from the ruins of Gadara. They visited the place and found them to consist of columns, tombs, remains of walls, theatres, &c., indicating ancient magnificence; and tradition reports that from one of these tombs the maniac of the time of our Savior issued. A description of the ruins, by Dr. Anderson, is appended to Lieut. Lynch's narrative.

In their conflicts with the rapids of the Jordan, a wooden boat which they had secured at the sea of Galilee for the transportation of their tents had perished, and the party were obliged in consequence to abandon their tents; this much needed protection against the expected heat of the Dead Sea, they appear to have been provided with in some other way. No boats but those of metal could have survived the severe shocks to which they were so often exposed; it was with the utmost difficulty in one case, that they were saved and two of the Arabs rescued from drowning. Rapids continued to occur, proving that the Jordan, except for short and isolated distances, is entirely unfitted for useful navigation.

The Jordan, like most other rivers, has successive terraces upon its banks, and two are very distinct. From a hill 300 feet high, they had a view of the terraces; they were shaped on both sides by the winter rains into conical hills, pyramidal, cuneiform and tent-like—resembling a giant encampment—extending as far south as the eye could reach; the river sometimes glittering through the openings, or "clasping some little island with its silvery arms," or dashing in white foam by some projecting point.

They continued on with safety through the 13th, but not without difficulty. The rapids were most formidable obstacles, proving fully that the representations of the Arab sheikhs were not exaggerated.

In the course of the day, they passed patches of wheat and barley. A beautiful alluvial country succeeded, but without cultivation, and overgrown by thistles and wild grass; large flocks of storks gazed unheedingly upon the caravan. The heat became intense, without a tree or a shelter in the vast plain—the sun's rays beating on their heads and reflected from the gun barrels which were painful to touch or behold, and the whole atmosphere quivering as it ascended in heated currents.

With a current of four to six knots an hour, on April 14th, the boats shot along rapidly, and so great were the windings of the river, that in the course of a quarter of an hour they ran towards almost every point of the compass—as if the holy Jordan were lingering in the calm and silent valley, reluctant to plunge into the salt and bitter sea.

The scenery of the river through the day had little variety; sometimes the current washed the bases of sandy hills or passed along low banks fringed with trees and flowers, and occasional views were highly picturesque; then the river became a raging torrent. Now and then a gurgling rivulet came flowing in, mingling its pure waters with those of the muddy Jordan. The high limestone hills formed a barrier on the western side against the overflowings of Jordan and the floods of the sea of Galilee in the winter and spring, while the low eastern bank fringed with tamarisk and willow and occasional thickets of cane and tangled masses of shrubs and creeping plants, was almost a jungle. A fresh track of a tiger was seen in the mud where he had come to drink, and at another time a wild boar dashed through the thicket and told his course by the sound of broken branches. Birds in many places sung in the trees, the real nightingale ceased not her song, and the bulbul—the Syrian nightingale—when disturbed, flitted to another bower and renewed her melodies. Rapids and cataracts continued to occur, and it required all the address, courage and strength of the crews, not unfrequently jumping overboard and clinging to the sides of the boats, to prevent their being swamped; they always steered for the most rapid part of the torrent, as this was the deepest. As twilight came on, the rapids were numerous, and from the decay of the light, more dangerous.

The river was now falling rapidly,—at the rate of about two feet in a day,—and frequently the sedge and drift-wood were seen lodged on the branches of overhanging trees, higher than the banks, "which conclusively proves that the Jordan in its *swellings*, still overflows the lower plain and drives the lion from his lair as it did in ancient times."

The eroded hills on the upper terrace had a conical form; limestone and conglomerate were the prevailing rock, and it was evident that the whole had been under water. Boulders of quartz and conglomerate were numerous.

From the nature of the country the caravan was compelled to keep at a distance from the river, and the scouts were visible only occasionally upon the bluffs and crests of the hills. Being now in a dangerous region near where Lieut. Molyneux's party was attacked, the land and water parties reunited and formed an armed encampment. The camels were reposing in close proximity, and arms and fires and the people were all around. The caravan, repelled from the western, now crossed over to the eastern bank, while the scouts travelled on the west, to keep a lookout from the heights of land for the safety of the boats, which alone were in danger; the signal of two guns in quick succession from the boats was again agreed upon, that the land forces might close in to their assistance. Some of the party were exhausted by fatigue and by frequent vomiting during the day.

The river varied between thirty and seventy yards in width, the current from two to six knots, and the depth from two to ten feet. On April 15, the heat in the morning was 76°, and it soon became oppressive. The mountains towards the east had a gloomy aspect, being rough and verdureless crags of limestone reflecting a blinding light. In this dreary waste there was no sound, for every living thing had retired from the withering heat and oppressive glare; the wind sighed as it swept over the barren plain; there was no drapery of clouds—the gleam of dawn deepened at once into the intensity of noon. Day after day followed without change; there were no shifting clouds and sunshine, but a monotonous and wearisome azure. The mountains towards the west rose like islands from the sea, the peaks illuminated by the sun-light being strongly contrasted with the dark shadows; and although they were hours away, their deep scars and fissures were distinct, and the laminations of the strata resembled the leaves of some gigantic volume. The plain sloped from the base of the hills into conical mounds, and still lower, into the valley of the Jordan. The banks of the river were fringed with perpetual verdure—the stream winding in a thousand graceful mazes, a bright line in a cheerless waste, bright by contrast with the harsh dry calcined earth around. There were no elms, ash, hazel, linden, beach or aspen; no laurel, pine, or birch; still the lily and tamarisk, the oleander, the anemone and the asphodel adorn the Jordan, and the bulbul and nightingale haunt the copses.

On April 16, at *the Pilgrims ford*, conglomerate was rarely seen, but in its place banks of semi-indurated clay. The vegetation became more luxuriant, the oleander more abundant, the asphodel and acacia less so.

Higher up the river there was drift wood in the stream, and bushes and branches were lodged high up in the trees which lined the banks. The bounding hills were immense masses of siliceous conglomerate with occasional limestone, this being the geological formation of the Ghor from Lake Tiberias to the Dead Sea. Rapids were still of frequent recurrence.

They arrived at *El Meshra*, the bathing place of the Christian pilgrims. Tradition assigns this as the place where the Israelites passed over with the ark of the covenant, and where our Savior was baptized by John; and near it, is supposed to have been Bethabara, the Savior's place of refuge. Here also is said to have been the scene of the Savior's temptation, and the fountain healed by Elijah. Near by was Jericho, and fourteen miles on the other side was Heshbon where Sihon, the king of the Amorites, dwelt. The water and land parties united in pitching their tents just at the spot where the pilgrims passed.

April 18.—The pilgrims arrived at 3 A.M. Thousands of torchlights with a dark mass of human beings, were seen moving rapidly over the hills, and they were on the ground almost before the tents could be struck and the place cleared. Men, women, and children, mounted on camels, horses, mules and donkeys, rushed impetuously down the bank as if they had been fugitives from a routed army. The Bedawin guard formed a cordon of defense, sticking their spears in the ground and mounting their horses, to prevent the American party from being run down—Moslems shielding one Christian band against another! The party which had arrived was only the van guard; at 5 o'clock A.M. the main body came over the crest of a high ridge in one tumultuous eager throng: "Copts, Russians, Poles, Armenians, Greeks, and Syrians from all parts of Asia, Europe, Africa and America." Many of the women and children were suspended in baskets or confined in cages: they dismounted, hurried forward, disrobed in haste, and threw themselves into the stream, regardless of observers. They took that plunge in honor of the Trinity and then filled a bottle from the river. They cut branches of the willow, dipped them in the consecrated stream and bore them away as memorials of their visit. The pageant disappeared as rapidly as it had approached and left the small party to their solitude. The number was said to be 8000, but probably this was an over estimate. All bathed, except a few Franks,—most of them reverentially, but a few with levity.

The course of the Jordan had been so tortuous, that in sixty miles of latitude, and four or five of longitude, the party had traversed at least 200 miles; and as they had descended twenty-seven threatening rapids besides many smaller ones, and at all times found a rapid current, it is not surprising that the Dead Sea is 1300 feet below the level of the Mediterranean. As they ap-

proached the Dead Sea, the river was forty yards wide and twelve feet deep, the bottom blue mud. A little further on, it was fifty yards wide and eleven feet deep, with muddy bottom, and low sedgy banks. The high mountains of the Dead Sea were in sight to the S. and W. A heron, a bulbul, a snipe, and many wild ducks were seen. The river now became seventy to eighty yards wide; and the water was still sweet: it was seven feet deep with a current of three knots. The *Dead Sea* was in view to the southward, with mountains beyond. A snipe, a heron, and a white gull were the only visible inhabitants of the region.

The mouth of the river is 180 yards wide and three feet deep; as they entered the sea a gale of wind compelled them to stand for the north shore, which they reached incrusted over with a greasy salt, and their eyes, lips, and nostrils smarting excessively. The sea subsided as quickly as it rose—its heavy waves in twenty minutes were stilled, and they went on, gliding over a placid sheet of water hardly disturbed by a ripple. A rain cloud which had enveloped the sterile Arabian mountains, now opened and disclosed their rugged outlines gilded by the setting sun; but above the still more sterile mountains of Moab, all was gloomy and obscure. The northern shore is an extensive mud flat with a sandy plain beyond, and is the very type of desolation. The line of high water was designated by trees, having their branches blackened or whitened by salt. The northwestern shore is a bed of gravel sloping from the mountains to the sea; the eastern is a rugged line of mountains bare of all vegetation.

The land party and the navigators were mutually embarrassed in their efforts to find each other. They pitched their camp "in a canebrake near a brackish spring, and wet, weary and hungry, reposed upon a bed of dust beside a fetid marsh—the dark mountains being behind and the sea like a huge caldron before, its surface covered with a lead colored mist." This solitude was relieved by the sound of the convent bell of Mar Saba, on the western side, informing them that Christian sympathies were near.

The shore party after leaving the Jordan, passed a sandy tract of damp ravines and slippery to the feet of the camels, succeeded by a plain incrusted with salt. The upper terrace of the Jordan, on which the party travelled, was generally about 500 feet above the plain, and the latter was mostly covered with trees and grass.

One of their encampments was under a cliff of crumbling limestone and conglomerate 1000 feet high, and near it was a spring of clear water at 84°; it was soft but brackish, and smelt of sulphur. Pebbles of bituminous limestone were very abundant. The vegetation being saline and acrid, the camels could not be sustained, and they and the Arabs who had attended the party

were dismissed. Upon the beach there were no round stones, but only those that were angular, and they were of flint. Two partridges of a stone color, like the rocks, were started before them, and the note of a solitary bird was heard among the cane thicket: birds therefore can live upon the shores of the Dead Sea.

"But the scene was one of unmixed desolation; and the air tainted with sulphuretted hydrogen, gave a yellow hue to the foliage of the cane which is elsewhere of a light green." There was no vegetation except of the canebrakes; "barren mountains, fragments of blackened rocks," and a saline sea with dead trees on its margin, bore a sad and sombre aspect.

Near their camp, on the 20th of April, they saw a large brown stone-colored hare and a partridge. The temperature was 89° F. At 8 P. M., "the surface of the sea was one wide sheet of phosphorescent foam, and the waves, as they broke upon the shore, threw a sepulchral light upon the dead bushes and fragments of rocks." This is an interesting observation, and as far as we know it is original. We have never learned that any such appearance has been observed in the Caspian or any other internal saline water. The luminous appearance probably arises from animalcules, such as are phosphorescent in the ocean; mere salt-water, however strong the solution, has no such power. We have then another proof that life is not entirely excluded from this region.

Soundings were taken in a course directed towards the eastern or Arabian shore, a distance of nearly eight statute miles; the greatest depth was 696 feet and 540 feet within a fourth of a mile of the Arabian shore. Mr. Aulick reported a volcanic formation, and brought specimens of lava. "Another line of soundings running diagonally across to the S.E., disclosed a level plain at the bottom of the sea with an average depth of over 1000 feet all across; the bottom blue mud and sand with regular cubes of crystallized salt." The greatest depth on this line was 1065 feet, and the greatest observed anywhere was 1278 feet.

These operations were performed under a blazing sun, and the water, greasy to the touch, made the men's hands smart and burn severely. "By dusk, the sea rolled dangerously, the crests of the waves dashed into the boats, the men had a severe pull, and their clothes were stiff with salt."

In a chasm in the mountains, on the eastern side, they found a sweet and thermal spring which flowed into the sea.

The brook Kidron which in rainy seasons runs in the valley of Jehoshaphat at the foot of the mount of Olives, empties into the Dead Sea in the Wady en Nar (Ravine of Fire); the bed is a deep gorge whose sloping banks rise 1200 feet; the channel was now dry and filled with confused fragments of rocks. The horizontal stratified limestone of the mountains, was almost devoid

of vegetation, presenting a scene of "utter and dreary desolation." At the foot of the cliff of Hathûral they observed narrow strips of cane and tamarisks—a luxuriant line of green—and almost the only verdant spot that had been seen for a long distance; a beach of coarse dark gravel below and barren brown mountains above bounding the prospect. Soda plants were found upon the shore. Sulphur picked up on the Jordan near the Dead Sea, was brought by an Arab.

The mountain at Ain Jidy (Engaddi) is 1500 feet high, and in its sides are many caverns excavated in former times, the mouths of some of which are now entirely inaccessible. It is a curious fact regarding the birds, insects and other animals of this region, that they are all of a stone color; this was the case with a cat-bird brought in by an Arab. Along the beach they saw a hawk and some doves, "all of the same color as the mountains and the shore." "Four young boars were brought in by an Arab; they escaped from him and ran to the sea and were caught, and because the Americans would not buy them they were killed." Sulphurous smells were not unfrequent, and sometimes the odor of sulphuretted hydrogen was perceived, probably from the springs and marshes along the shore.

On the 21st they made an encampment as a point of rendezvous for their surveys, and called it "Camp Washington." There is a peninsula on the southern side of the sea, for which they now steered, leaving a party at the camp for the purpose of triangulation. The peninsula is a broad bold promontory forty to sixty feet high, with a central ridge elevated some twenty feet more, and a foot of sand, salt, and bitumen; the vertical face extending all around had a coarse and chalky appearance. Dr. Anderson thought the peninsula to be one-third higher, and to consist of a calcareous marl; a part of it he found chalky, with flints. "There were a few bushes, their stems partly buried in the water, and their leafless branches encrusted with salt," which with the dead trees, standing and prostrate, were the only vestiges of vegetation. The mind cannot conceive a more dreary scene, or an atmosphere more oppressive. The distance from the point of the peninsula across to the western shore was ascertained to be about nine statute miles, and the greatest depth of the water 1128 feet. All the party were affected by drowsiness while crossing the water, and on the land the oppressive heat and sulphurous odors produced sickness.

They now made an expedition around the southern shores. There was a "perpendicular isolated cliff called Sebbeh or Masada, 1200 to 1500 feet high, and on its summit a line of broken walls with an arch, constructed as it is said, by Herod; it had a commanding but dreary prospect, overlooking the deep chasm of this mysterious sea." Near the south end of the sea they ob-

served other ruined walls and remains of architectural structures. Bitumen was seen upon the beach; it had a bright smooth surface like a consolidated fluid.

The weather was intensely hot; the awnings of the boats erected for tents on land afforded no adequate protection, and at midnight the sirocco, although from the N.W., raised the thermometer to 86° and 88°. The people lay in the open air upon the pebbly beach of this desolate sea. In the morning a young quail was found nested by the side of the commander, as a refuge from the hot wind.

The salt mountain of Usdum or Sodom was near at hand. It is perfectly isolated but has no appearance, externally, of being a mountain of salt. Seetzen saw this salt mountain in 1806, and says that he never before beheld one so torn and riven. On the eastern side of Usdum is a lofty, round, detached pillar, which on examination, was found to be composed of solid salt, capped with carbonate of lime. The upper or rounded part is about forty feet high, resting on an oval pedestal from forty to sixty feet above the level of the sea. It is slightly conical, crumbles at top and is crystallized throughout in spiculæ. A kind of buttress connects it with the mountain behind, and it is covered with debris of a light stone color. Josephus and his cotemporary Clement state that they had seen a pillar of salt which they believed to be identical with Lot's wife, and this may be the one to which they had reference.

Large specimens of the salt were brought away in the boat. The water was so shallow that they could not approach within 200 yards of the beach; throughout the southern part of the lake the depth was rarely over two feet, and frequently less than one foot. The foot prints made by the party on landing were on their return encrusted with salt. Mr. Dale landed, and his feet sank twelve inches in slimy mud, then through a crust of salt, and then another foot of mud before reaching a firm bottom. The beach was so hot as to blister the feet, and when one of the men attempted to carry Mr. Dale, both sunk down, and they were obliged to run as they could—it was like running over burning ashes, and when they plunged their feet into the slimy brine at 88°, the sensation of comparative coolness was delightful.

The scene around them was one of unmitigated desolation. On the south stood the rugged and water worn salt mountain and pillar; on the east the lofty and barren mountains of Moab, in a cave in which Lot is supposed to have taken refuge; on the south the high hills of Edom half surrounding the salt plain, the scene of Israelitish victories; and to the north the calm and motionless sea curtained with night. The atmosphere was difficult of respiration; the air oppressively hot, the temperature being 97°, and that of the water 90° twelve inches below the surface.

Lieut. Lynch named the northern extremity of the peninsula Point Cortigan, and the southern, Point Molyneux, in honor of "the two gallant Englishmen who lost their lives in attempting to explore this sea." Near the base of the peninsula there is a range of hills 2000 feet high; the cliff called *Little Tiger* consists of horizontal strata of brown and rose colored limestone.

At 3·50 P. M., a hot hurricane struck them, temperature 102°, and with severe exertion they gained the shore, exhausted by hard pulling of the oars, and the commander's eyelids blistered by the hot wind. The men had great difficulty to protect themselves, some in the ravine, some under the awnings of the boat; the metal of their spectacles burned the face, and their buttons the hands; and the folds of garments next to the body were coolest.

They found an old millstone upon the beach and huge boulders of sandstone in the ravine, strata of sandstone above in horizontal layers and limestone upon it. Bathing in a pool of fresh water afforded a momentary relief, but in an instant the moisture was evaporated, and the surface was dry and parched.

The wind rose to a tempest; the heat increased after sunset, and at 8 P. M. was 106°; it was more like the blast of a furnace than the living air. Drinking did little good, for without any sensible perspiration the fluid was evaporated as fast as received. Musquitos tormented them almost to madness, and they passed a miserable night. When the water was exhausted and all were too weary to go for more, they threw themselves upon the ground, eyes smarting, skin burning, lips and tongue and throat parched and dry, and some garment wrapped around the head to avert the stifling heat. At midnight thermometer 98°.

Flocks of birds were seen and storks in the early dawn of April 27. A miserable tribe of Arabs gathered on the shore to see them depart. A glassy undulation indicated the coming of a hot gust of wind, and with some difficulty they reached the shore before the sea was all in a foam. The night was passed where there was no fresh water, but they had the luxury of a beach of pebbles far preferable to the mud and dust of their late sleeping places. They picked up pieces of sulphur and saw the track of a panther in a cave. They found the Arabs of this region indispensable auxiliaries; they brought them food and drink; they acted as guides and messengers, and in the absence of the adventurers, carefully guarded their camp. A decided but courteous manner wins their respect and good will.

The tendency to drowsiness upon the sea was now extreme; all slept except the men at the oars who pulled with half closed lids, and the steersman who was the commander, was little more awake. On the 28th they received news from home announcing the death of John Quincy Adams, and it was hard in their

dreary solitude to divest themselves of the idea that there was nothing but death in the world and they alone alive. They picked up large pieces of bitumen on the sea shore. A breeze from the west passing over the marshes brought with it a nauseous smell.

Till the 30th, with a single exception, all had been well; but now dropsical appearances began—"the lean had become stout and the stout almost corpulent; the pale faces had become florid, and the florid ruddy; the slightest scratch festered, and pustules followed—the sea water irritated the sores excessively; yet all had a good appetite." Except the smell from the marshes, and from thermal springs, there were no indications of malaria, the sea itself being perfectly inodorous. The appearance of the men was distressing. Some with their bodies bent and arms dangling slept profoundly, but with a flushed and feverish sleep; others with heads thrown back and lips cracked and sore, seemed, even in sleep, to be worn down by heat and fatigue; others from reflected light looked ghastly, their limbs twitched, and they would start suddenly from sleep.

Prudence therefore demanded a return, although they were reluctant to leave any part of the work unfinished. Partly for recreation, they accepted an invitation from the Christian sheikh Abd 'Allah, to visit Kerak, on the mountains of Moab, seventeen miles east of the Dead Sea.

While the party were waiting for horses, they "dined *sumptuously* with the Arab Christians, on wild boar's meat, onions, and the last of their rice." Their horses arrived, and with them, Muhammed, the son of the Muslim sheikh, and also Abd 'Allah the Christian sheikh himself, the latter residing in Kerak, and the former chiefly in black tents about half a mile from Kerak. Muhammed being about to mount his horse, ordered one of the Fellahin (a common Arab) to stoop, and "placing his foot upon the abject creature's back, he sprang upon his horse;" his countenance and manner were insolent and overbearing, while Abd 'Allah, the Christian sheikh, his senior by twenty years, was mild and even meek.

The boats excited great surprise, and both the Muhammed and Christian Arabs were indulged in an excursion by rowing upon the sea. "They stuck plugs of onions in their nostrils to counteract the malaria they had imbibed from the water." They call it "the sea accursed of God," and thought it madness for men to remain so long upon it. The party consisted of fourteen besides the interpreter and cook, and the escort of twelve mounted Arabs and eight footmen, besides a number who had gone ahead. They crossed a plain of tertiary formation, ferruginous and friable limestone, marls, &c.

They passed up the Wady Kerak, the path extremely steep and difficult, and the scenery very wild and grand; on one side a deep chasm, on the other high overhanging cliffs, and a fierce thunder-storm which soon came on poured a powerful torrent along the gorge, bearing rocks before it that made the region resound with their collision. Excepting a single palm bending in the tempest, they had not seen a tree or shrub since they turned up the ravine, but only mountain ruins of naked rocks piled up in wild grandeur along a zigzag path. They saw much of the scarlet anemone, also a blue flower resembling the convolvulus, and partridges, hawks and doves, were their attendants. The cavalcade wound up along a circuitous ascent, and limestone, some of it fossiliferous, accompanied them quite to Kerak.

A little after noon they came upon the brow of a hill 3000 feet above the Dead Sea, at the N.E. angle of the town. They passed along a wall and by a tower, and entered the town under an arch cut in the solid rock thirty feet high by twelve wide; a partly effaced Arabic inscription was over the gateway; they proceeded through a passage eighty feet long, and found the town to be a collection of stone huts built without mortar. They were from seven to eight feet high (from the ground floor?), the ground floor is about six feet below, and the flat terrace roof about two feet above the streets, and the people were assembled on the dirt-heaps and roofs to see the strangers pass. The council-house is the Christian school-room, and there is a work-room below. A Christian church was building; it was seventy-four feet by forty, and twelve feet high.

The room for the travellers had a naked stone floor and a mud roof supported by rafters, two windows without glass or shutters, and a door without fastenings. Their food was eggs and milk, three eggs for each for a dinner. There was only one shop, and that contained thin cakes of dried and pressed apricots, and English muslin. The huts had neither windows nor chimneys, the inside was smoked, and the women and children were squalid and filthy. The population of Kerak is about 300, three-fourths Christian, and the entire Christian population here 900 to 1000.

The castle was originally a vast and magnificent structure, partly excavated from and partly built upon the mountain top; the architecture is a mixture of Saracenic, Gothic and Roman, but its history appears to be obscure.

On the 3d of May the party, not without danger from the Muslim Arabs, made their way back to their boats. They now commenced their return along the eastern or Arabian shore. Mountains of red sandstone variegated with yellow were passed, with white cliffs in the background. The next day the shores presented boulders of trap, and the mountain appeared to be composed of scoria and lava. The scenery was grand and wild. A stream,

called Zerka, the outlet of some hot springs, had formed a deep ravine; the walls were 80 to 150 feet high, of red and yellow sandstone in vertical cliffs. The party slept on the gravelly beach; the thermometer from 70° to 68°, and they suffered from the cold.

On May 5th, in crossing the sea to Ain Turâbeh, at two furlongs from land, the water was 138 feet deep; five minutes after it was 1044 feet, gradually deepening to 1308 feet, the bottom brown mud with crystals of salt. They continued on their course, and on the 9th made arrangements to leave the Dead Sea. A large float was moored in eighty fathoms water, with the American ensign flying. Sickness was already appearing among them, and two seamen were sent to the convent of Mar Saba.

This sea, according to Dr. Robinson, is about fifty miles long and ten broad. The specific gravity of the water is 1·13, while that of the Atlantic in lat. 25° N., 52° W. long., was 1·02. The boats, when afloat on the sea, drew one inch less of water than when on the Jordan. No animalcules or animal matter were detected in the water by a powerful microscope.

The party had now passed twenty-two nights upon the Dead Sea. They had carefully sounded its depths, ascertained its geographical position, the topography of its shores, and the depth, width and velocity of its tributaries, as well as the winds, currents, weather, &c.; and numerous specimens had been obtained.

Remarking upon the character of the region, Lieut. Lynch observes, that the extraordinary nature of the soundings appears to sustain the inference from the Bible, that this entire chasm was a plain sunk and overwhelmed; for the bottom of the sea consists of two submerged plains, one averaging thirteen feet, and the other thirteen hundred feet below the surface. Through the latter or northern one, runs a ravine corresponding with the bed of the Jordan and with another ravine, Wady el Jeib, at the south end of the sea. Many other considerations are mentioned, tending to shew that the basin of the Dead Sea is a sunken plain. Those of the party who were skeptical when they entered on the examination, appeared to be convinced that the Mosaic account was true.

On the 10th of May, they took leave of the Dead Sea, casting a farewell look at its waters as they wound up the ravine and encamped at an elevation of 1000 feet. Their boats were sent in sections to Jerusalem. They were now in a most dreary country of barren hills and valleys, without tree or shrub, and as still as the Lethean sea which they had just left. This was the wilderness of Judea, where God conversed with Abraham, where John the Baptist preached, and at the head of the next ravine is Bethlehem, which stands in full sight of the Holy city.

Passing the brook Kidron on the 15th, they found a large cistern hewn in the rock, twenty feet long, twelve wide, and eigh-

teen deep; the water was only four feet deep and was covered with a green scum, and two Arabs were bathing in it; yet the whole party, men and animals were, nevertheless, constrained to drink of it.

The whole region is one of entire desolation from the Mediterranean to the Dead Sea, except where water redeems here and there a patch in a ravine or valley for crops or verdure; a small patch of tobacco in a narrow ravine was guarded by an Arab with a long gun, and there was wheat and also barley in a valley skirting the base of the hill. Lieut. Lynch finally came in sight of the Holy City, elevated, as was ascertained by his levelings, 4000 feet above the Dead Sea.

On the 29th they planted their spirit level on the bank of the Mediterranean, one mile and a half south of Jaffa, having carried a line from the Dead Sea through the desert of Judea over mountain ridges, ravines and precipices, and most of the time under a scorching sun. It was conducted by Lieut. Dale, and corresponded with the triangulation of Lieut. Symonds, R. N. They "found the depression of the surface of the Dead Sea, below that of the Mediterranean, about 1300 feet: the height of Jerusalem above the Dead Sea is about three times this amount; and that height is almost the same multiple of the depth of the sea."

Their work being accomplished, they were hospitably received at the country house of Mr. Murad, the American Consul, which was placed at their disposal; and here they remained till June 6, busily employed in posting up and digesting their observations.

On June 7, they left Jaffa for St. Jean d'Acre, a land party under Lieut. Dale, and the remainder of the party with Lieut. Lynch, in a chartered boat. At Acre they re-embarked their effects brought over from Tiberias, and prepared for an excursion to Nazareth and the source of the Jordan.

June 10.—They left Acre and arrived at Nazareth by the way of the valley of the Winds, a place secluded among mountains, and containing about 5000 inhabitants. They ascended Mount Tabor, the reputed scene of the transfiguration. From the summit is a magnificent view of the plain of Esdraelon, bounded by Carmel on the west, and Gilboa on the south. N.W. is Nazareth, N.E. the sea of Galilee and the snowy peak of Mount Hermon. They again visited the lower source of the Jordan, and passed along the western bank of the Dead Sea to Bethsaida on the north, and ascending the high hills they enjoyed a good view of the rapid and turbulent Jordan rushing down in one line of foam, and thus they went on to L. Merom, and beyond it to Cæsarea Philippi, and still farther on they came to the real source of the Jordan, a fountain or several streams bursting from the side of a hill. The river gushes out copiously from a rock about forty feet high, forming the principal feature of a very picturesque landscape.

On the 17th, Lieut. Lynch and Lieut. Dale visited the valley of the Leontes or Litany, running near the Lebanon range. They saw in this region pits of bitumen; there are five in all, but only two were in operation, one sixteen and the other twenty-five feet deep.

On their way to the plain of Damascus, Jan. 19, they passed over Anti-Libanus. The lower parts were terraced and covered with vineyards and olive and mulberry orchards, above were oaks, then heath and fern, lichens and moss, and at the summit limestone and boulders of quartz. They crossed in a gorge between Mount Hermon and the next peak to the south. The two crests and many clefts on both sides were covered with snow. The summit of Mount Hermon is estimated to be about 9000 feet above the sea level.

As they descended, the limestone disappeared and gradually gave place to sandstone, and trap and serpentine appeared lower down. The prevailing rock, the next day, was granite with metallic veins and quartz. They passed rapidly from wintry cold to summer heat. Damascus is situated at the foot of Anti-Libanus. We shall not attempt to recount the description of Damascus—its bazaars, its cafés, its lazy smoking population, —its baths—its narrow streets and innumerable dogs over which the stranger stumbles. The population is estimated at 115,000. It was very gratifying to the travellers to meet their countrymen, the Rev. Dr. Paulding and Rev. Mr. Barnet, of the American mission, to whose hospitality and kindness they were much indebted. As many of the party were threatened with illness, they hastened on to Beirut; they seemed to have imbibed the disease which had heretofore prostrated all who had ventured upon the Dead Sea.

On the night of the 29th, after they had encamped, (it was in the cold mountain air 4000 feet above the sea,) Mr. Dale was attacked with the same symptoms as the other sick persons. At eleven o'clock the next day, Beirut and the sea were in sight, but the sick were ready to fall from their saddles; happily they met Dr. DeForest of the mission, who prescribed promptly.

July 1.—Lieut. Lynch, Mr. Dale and two seamen, required immediate medical attendance, and all hands were nearly sick.

This interesting narrative closes with the death of Mr. Dale, who, despite of all the care and kindness of the American missionaries and physicians and their families, sunk beneath the fever, and was buried at Beirut with military honors.

In leaving this work which has afforded us much instruction, we add a word to express our estimation of its value. It does honor to the zeal, intelligence, and moral feeling of the author; and his brave companions are entitled to the thanks of their fel-

low men. We think, however, that it is susceptible of improvement, and that in another edition it will receive some condensation and pruning, that will render it still more graceful and impressive. Its moral tendency is excellent, and no believer in the truths of the Bible can peruse the volume without feeling his mind much enlightened and his faith invigorated.

SEN. EDITOR.

ART. XXII.—*Second Memoir on the Conducting Power of Solid and Liquid Bodies;* by ED. BECQUEREL.*

M. PELTIER, as is well known, showed that the elevation of temperature at the point of junction of two conductors of different metals conducting a current, differs according to the direction of the current, that of other parts of the circuit remaining unchanged, and that when the current passes from antimony to bismuth,† an elevation of temperature takes place at the point of junction and a depression when it passes in the opposite direction.

The author concludes from his researches that generally the thermo-electric current generated by heating the point of junction of two different metals in a circuit, tends to produce a depression of temperature at that point of junction. In other words, the state of inequality of temperature produced by an electric current in a heterogeneous circuit is the inverse of that by which the current itself would be produced. Hence a certain portion of the heat employed to generate a thermo-electric current is consumed by the latter, and must be replenished by the heating source in order to maintain the current. This view it may be important to remember in the arrangement of thermoscopes for certain purposes.

He concludes farther, that resistance to conduction, in a heterogeneous circuit, as might be anticipated, does not seem to change with the direction of the current except so far as it may be a consequence of the change of the temperature induced by reversal of the current.

Resistance to the passage of the electric current between solid and liquid conductors.

This, technically termed by the author "*resistance to transit,*" is universally attributed to the chemical affinities that must be dissolved by the passing current, nor are we inclined to believe any part of it is to be attributed to a distinct force classed by the

* This article is an abstract of Becquerel's second memoir, prepared for this Journal by Mr. JONATHAN H. LANE of the Patent Office, Washington.

† The reverse order is stated in Becquerel's article, but this we presume must be an oversight.

author and referred to *heterogeneity of the circuit.* He does not appear to decide on the actual existence of such a force. In considering the chemical force the term *polarization* of the electrodes is used throughout in a manner seeming to imply that the polarization is an absolute obstacle to the decomposition and the passage of the current, so that the latter meets with greater resistance to transit than it would with electrodes that were perfectly neutral in their relations to the elements set free and evolved them at once as gas without attracting a particle of them to their surface, the electrolyte itself being supposed also to have no attraction or solvent power for the gaseous elements. Whether this be the author's view does not seem certain, but to us it appears that in proportion as the electrodes become perfectly coated with the films of oxygen and hydrogen evolved by a passing current, water being the electrolyte, the more nearly will the forces encountered by the current approach identity with those which with the neutral electrodes just mentioned, it would have to encounter from the first instant of its passage. In this latter case the oxygen and hydrogen from the first instant of decomposition will be set free in the absence of any body for which they have any sort of attraction, and it is only in such case that their separation by the current is opposed by the whole force of their affinity for each other. But if the electrodes or the fluid or both have an attraction for the oxygen and hydrogen to be separated, such attraction facilitates the separation and diminishes the electro-motive force required to effect it, and it is not till after the electrodes have become completely coated and the adjacent films of fluid saturated with the oxygen and hydrogen respectively, that we approach that state of the forces that is presented by *neutral electrodes* and in which each element is *set free.*

If it be objected that the attractions for the oxygen and hydrogen are equal at each electrode and ought to balance each other, it may be replied, that they act with reference to the alternative whether they shall be satisfied not at all or shall be satisfied in the only way in which they can be, that is, by giving the oxygen to the positive electrode and the hydrogen to the negative. This *alternative*, it will be seen, has reference to the case in which the electromotive force is just insufficient of itself to produce the decomposition and is supposed to do so by aid of the attractive forces in question.

If this view be correct, it seems probable that the amount of electromotive force necessary to carry on the decomposition after the polarization is established and the elements are all evolved as gases, is precisely that which is competent to the separation of these elements with electrodes having no action on them, unless it be a merely catalytic action, so that the elements assume the gaseous form in contact with them with the same readiness as in

contact respectively with the polarized platinum plates. It is true that on the cessation of the polarizing current the polarized electrodes are capable of generating a reverse current, but that only results from the continued action of the same affinities which have to be dissolved by the primary current, either in the case of the *polarized* electrodes or the hypothetical *neutral* ones.

The principle we would venture to suggest for estimating the resistance to transit in any case may be stated thus. Each of the affinities concerned, viz., those dissolved or those satisfied, may be considered equivalent to a definite electro-motive force; let the sum of such forces belonging to the affinities dissolved be represented by F, and of those belonging to the affinities satisfied by F′; all affinities that do not take effect, either in the separation or the combination of elements being neglected, and including under the term affinity all attractions that are capable of modifying the form or chemical action of a body, attributing also a definite force to the catalytic action of the electrode in facilitating the evolution of the element when that takes place,—then representing the resistance to transit by E, we have $E = F - F'$.

We are not aware indeed that any systematic experiments have been made to demonstrate this principle; but we think it sufficiently probable in the present state of our knowledge on the subject. We have seen something like this hinted at by some authors, but do not recollect to have seen it definitely laid down.

In the first experiment noticed by the author under the present head, the current was passed through a solution of sulphate of copper and positive electrode of copper and negative of platinum. The resistance to transit being accurately measured apart from the resistance to conduction, proved to be actually null or at least within the probable errors of experiment. Here the affinities dissolved on one side are satisfied on the other, reproducing, so far as we know, precisely the same state of things, so that $F - F' = E = 0$.

Mr. Smee mentions a curious circumstance respecting the action of compound batteries that very beautifully illustrates the same thing. If the exciting acid of one pair of the series be saturated with the zinc before that of the other pairs, the solution of the salt of zinc in that pair is electrolyzed and the zinc deposited on the negative plate, and this process extends from pair to pair of a series of twelve or more until the zinc is deposited on the negative plate of every pair except one, the action remaining in the last pair being sufficient to decompose the salt of zinc with zinc electrodes in all the other pairs.

In cases where gases were evolved from one or both electrodes, the general result obtained by the author is, that the *apparent* resistance to transit, i. e., all resistance over and above the simple resistance to conduction due to the liquid and other parts of the

circuit, is nearly constant, and does not, like mere resistance to conduction, increase in the ratio of the quantity of current. A trifling increase with an increase of the quantity did uniformly manifest itself, but this we imagine is to be attributed rather to increased mechanical obstruction from the gas than to any increase in the energy of the chemical forces. It may however be in part due to the solution of part of the evolved gases in the liquid, this solution being proportionally less with the stronger currents.

When in the electrolysis of water acidulated with $\frac{1}{2}\frac{1}{0}$ of its volume of sulphuric acid the positive electrode was of copper, the resistance to transit was only from ' to $\frac{1}{6}$ of what took place when platinum formed the positive electrode. With the positive electrode of platinum the *apparent* resistance to transit was nearly the same whether the negative electrode were of platinum or copper, being apparently a very little greater in the latter case than in the former. In comparing these two cases by the numbers given by the author, due allowance must be made for the different size of the electrodes used, or we should be liable to overrate the difference fairly attributable to the results. This slight difference of action between the platinum and copper as negative electrodes, (the affinities brought into play in the two cases being the same,) may be referred to the different catalytic action of the polarized platinum and the polarized copper plates in causing the evolution of the hydrogen as gas with greater ease in one case than in the other. Even a greater or less degree of roughness of the surface of the electrode appears, according to Mr. Smee, to produce a difference of this kind appreciable without the aid of the nice measures of Mr. Becquerel. Or the difference may on the other hand have been due to difference of temperature or some other circumstance.

ART. XXIII.—*Ko Doü Dzu Roku, or, A Memoir on Smelting Copper, illustrated with plates.* Small folio, pp. 20. Translated from the original Japanese.*

THE *Ko Doü Dzu Roku*, which we present our readers in an English dress, is a thin pamphlet of twenty leaves, fourteen filled with plates and explanations written in the Japanese hirakana character, and six with Chinese writing. There is neither preface nor exordium to the work, which being a very commendable example, we shall follow, premising that throughout the translation, the original is indicated by marks of quotations. We will, however, just add a record of our hesitancy in presenting this performance to our readers. The natives who have acted as

* From the Chinese Repository, 1840.

our teachers, are sailors or tradesmen, persons in ordinary life and of common education, and who in their own country would probably have never attempted to read a book on metallurgy. They know but little more than how to read simple works, or write mercantile letters.

PLATE I. *Of digging the ore.*—This plate is in two compartments; the first represents a miner entering the mouth of the pit, carrying a lamp in one hand, and a pick in the other, with an empty basket swung on his back. At the entrance, he meets a second miner just coming out with a basket of ore. The second shows the same person reaching the extremity of the mine, where is a third workman engaged in cleaving the ore from its bed.

This, and all the succeeding plates are painted; the colors are everywhere laid on in an artist-like manner, though the cheapness of the work apparently forbade much labor.

"The copper, as it comes from the hills, is undoubtedly in the form of ore; the ore is the effluence of the copper, and in a serpentine vein it rises and appears upon the top of the hill. There are many sorts of ore; that which is of a reddish black color, soft and not very heavy, and taken from veins running from east to west (or horizontally), is the best. The overseer of the mine examines and assorts the ore. Rafters, planks, joists, pillars, &c., are used to uphold and prevent the mouth of the mine from caving in. When commencing, the rock is worked with hammers and chisels; the [barren] stones are thrown away as they are dug, and the ore is brought out; by degrees the hill is penetrated, and the hole thus formed is called a mine. A lamp made of a shell is used as a light, and the quarried stone, put into baskets, is carried out on the back. Wherever the quarrying has been done, rafters, planks, and pillars are set up to restrain the overhanging rocks lest they fall. There are many kinds of both good and bad ore. When the mine has been dug deep, the air does not permeate it, and the lamp goes out; therefore, in places above the mouth of the pit, holes are cut down reaching to the mine, opening into it in many places, and secured by planks, rafters, &c.; they are called *shiyaku hachi* or flute-holes. Thus the wind is made to circulate. The whole is called *fuki mawashi* or wind-ventilator."

PLATE II. *Assorting the ore.*—This plate exhibits a company of women, with hammers in hand, pounding the ore, and separating the barren stone; one of them has her child strapped to her back. A copper tea-pot stands hard by, and one old dame is enjoying her pipe while plying her hammer.

"Among the ore there are both rich and poor kinds, combined with the plain rock; the poor is separated from the stone, which is then thrown aside, and called refuse stone. This is the employment of old men and women."

PLATE III. *Draining the mine.*—In this plate, we have a section of one of the "flute-holes," and three lifting-pumps represented, emptying into each other by means of water-boxes placed on shelves cut in the rock, where also the laborer stands to work the pumps. The lifting-pump is not known to the Chinese, and we were not previously aware that the Japanese were acquainted with it. How invaluable would be the gifts of a steam-engine to the Japanese miners, toiling day and night to raise water from the deep mine, and of a safety-lamp to him who now works by the light of a shell-lamp! The darkness or the depth of the mine is intimated by lamps placed near the pumps; and the painter has very cleverly represented the light proceeding from them by leaving a circle of white around the flame, the surrounding rock being a light umber color.

"In obtaining the ore, as the mine descends deeper and deeper, and the digging is low down, the water bubbles up, making the labor difficult. Therefore wood and bamboo, prepared in pieces about thirteen feet long, are placed one above the other, and these tubes (or pumps) are inserted into water boxes; several tens or hundreds of strokes are required, according as it is deep or shallow. They are worked uninterruptedly, day and night, to draw the water to the surface. In this manner of operation, there is a great consumption of the strength of the workmen, and they cannot progress very fast; wherefore proper spots are selected for raising the water. Below, in the mine, several perches intervene between them, and there they are also guarded from caving in; they are cut down to those spots in the mine where the water collects, and are called *midzu nuki*, or water-drainings. In all of them the wind circulates. The expense of making them in this manner is exceedingly great; the miners construct them according to their own ideas, and they are indispensable. From thirty to fifty years are occupied in making them."

PLATE IV. *Roasting the ore.*—In this plate, the artist has apparently endeavored so to foreshorten his drawing, that the roof shall appear high above the kiln; if such was his intention he has rather failed, for the roof is drawn so near to the fire bursting from the kiln, that it would soon be consumed, were it so built. The kiln appears to be built in a solid and permanent manner, but without the covering of straw mentioned in the text.

"To roast the ore, a kiln must first be built, having vent-holes in it, through which the draft will pass to the fire. Faggots are spread upon the bottom of the kiln, and the ore laid upon them in rows, and thus alternately, faggots and ore, until the kiln is full. A covering of matting, straw, thatch, and other similar things, is then placed over it, and sprinkled with water, and the fire lighted at the mouth. Generally it burns thoroughly in about thirty days, and when cooled is taken out."

PLATE V. *Smelting the ore to extract the coarse metal.*—The furnace, in this plate, is represented as sunk in the earth, and the smelter is standing over it with a long shovel in his hand to manage the fire. The bellows, which is separated from the furnace by a wall, is made like the Chinese *fung seäng* or wind box, of which a description is given in the Repository, vol. iv, page 37.

"The ore being roasted, is put into a furnace, where coal is employed to melt it; the scoria having flowed off, the coarse metal is taken out; it is copper imperfectly purified."

PLATE VI. *Taking out the copper when the coarse metal is fused.*—This plate is intended, as supplementary to the last, to exhibit the mode of taking out the copper, after a second melting of the coarse metal. The fire having gone down, a workman stands over the furnace with a broom, with which he sprinkles the metal as a second workman takes it out on the end of a hooked pole; a third is represented as having just thrown a mass of metal into a pool of water.

"When the coarse metal is melted in the furnace, and the scoria has flowed off, the copper is taken out."

PLATE VII. *Of fusing silver and copper together.*—This plate resembles the preceding, but is intended to represent the taking out of metal after a second melting, when the silver is still alloyed with it. In this plate, a bellows is drawn on each side of the furnace, in lieu of the double-handled single one in the preceding plate. While one workman is engaged in sprinkling and taking out the copper from the furnace, a second is plunging a large mass into a tub of water. The title of the plate literally means "together blown," and is rather a second purification of the copper ore than alloying it with silver.

"The silver which is mixed up with the copper is melted, and the scoria taken out; it is therefore called *mabuki doü*, or alloyed copper."

PLATE VIII. *Casting the bars.*—Here we have a large sinewy man represented pouring the melted metal out of a large crucible into a wooden pool full of water, while another opposite to him holds a pair of pinchers to take out the bars. The exhibition of muscular tension in the drawing of the gigantic man who holds the crucible is creditable to the artist.

"The alloyed copper is put into an earthen crucible and fused, and then poured into molds to form the bars of copper. These bars are sold to foreigners, and are as excellent as if for imperial use. That which natives buy is smelted in the same manner, but the mode of casting and the molds are different; therefore these are in all sorts of shapes; one is made by pouring the copper into a bamboo stuck in the ground."

PLATE IX. *Fusing lead with the copper.*—In this plate, one workman, his face muffled and his legs guarded from the fire of the furnace by a mat, has just taken out a mass of copper, and

placed it in a trough, while a second, with a spade-like tool, is assisting him in working it.

"When silver is combined with the copper, lead is added to it and they are melted together; it is then called *aïbuki doü*, or combined-melted copper."

PLATE X. *Separating the lead from the copper.*—In the previous plates, the form of the furnace has been the same, that of a caldron imbedded in the ground even with the surface of the earth, having the bellows placed on the other side of the intervening wall, and the blast carried into it below its level. No covering is represented, and the flame ascends into a cowl chimney. In this plate, the form of the furnace is oblong, with a curved facing in front; a fender kept in its place by a rod attached to a post, guards the liquid metal from running out, except at a small orifice, which the workman manages with his spoonlike rod.

"The 'combined-melted copper' is put into the furnace and heated almost to liquifying, when the workman holding an iron tool upon the surface of the copper, restrains it from flowing, but allows the melted lead to run off. The copper is called *shibori doü*, or wrung out copper, i. e., pure copper. By this process the silver and lead contained in the copper are extracted, whence it is termed 'the wrung-out (or purifying) fusing;' the rules for the process were derived from foreign countries, and it is on this account also called 'the fusing of the southern foreigners.'"

PLATE XI. *Separating the silver from the lead.*—The furnace in which the cupellation is performed resembles a cupola furnace, rising about three feet, and having the fire somewhat below the surface. The assayer is stooping over the fire, intently watching the metal.

"The lead previously extracted is put into an ash furnace, and slowly melted by a coal fire; the lead sinks to the bottom among the ashes, and the pure silver appears coming out of the centre. It is called *hai-buki gin*, or 'ash-melted silver.'"

PLATE XII. *Of rinsing and sifting.*—Here we have two tubs of water, at which are women rinsing the pounded scoria; troughs stand by them for receiving the metallic portions, and a workman is shoveling the heap of scoria.

"Within the earthen crucible, used in melting copper, there is an earthy residuum, which, with the scoria, is put into a stone mortar, pounded fine, and afterwards rinsed. As the water in the bowl flows off, the earthy particles being light also run off as useless. The cupreous portion, being heavy, remains in the bowl, whence it is taken."

PLATE XIII. *Fusing lead.*—This plate is supplementary to those on copper, introduced probably on account of the frequent mention of lead when speaking of copper. The furnace is represented as distinct from the crucible or caldron in which the lead

is melted; the fire is underneath it, and communicates with the bellows below the surface. The fire is pictured as having gone down, one workman is lading lead into small oblong molds, while a second is cooling them in a tub of water, and a third cording the bars of lead into small faggots.

"The ore of lead comes from the hills; it is fused in a crucible; and afterwards poured out into copper molds to form bars of lead."

Succeeding these thirteen plates are as many more, representing the implements used in smelting copper and lead and specifying their names and uses. To the professed metallurgist, this would be a very interesting part of the work; but it will be neither entertaining nor profitable to our readers to be detained with a minute description of them. There are one hundred different drawings, representing the iron ladles, rods, forks, skimmers, pincers, &c., with the sieves, brooms, tubs, crucibles, molds, mortars, weights, &c., employed in the various stages of the smelting. The last page is occupied with diagrams of the bellows.

The remainder of the volume is filled with an account of the process connected with extracting copper from the ore, written in Chinese, and corresponding in the main to the Japanese. It is explanatory of the former, and renders the whole account much more complete than it otherwise would be. It is drawn up in excellent Chinese style, and is a good specimen of the capabilities of that language to describe even the most technical operations. The Japanese writer has added the terminations of the cases, the prepositions and other grammatical marks by which a native of that country is enabled to read Chinese with much more facility and accuracy than he otherwise could do. In the translation, we have introduced the Chinese characters along with the names of places, in order that the means may be afforded for ascertaining their native names by those who have access to educated Japanese. These, in many instances, are so different from the sound of the characters themselves, as to afford no clue whatever to the names of the places designated, if the reader does not happen to know the very characters employed to write that name. Thus, the three great cities in the empire, Yedo, Ohosaka, and Kioto (or Miyako), are severally written *Keänghoo*, *Taepan*, and *Kingtoo;* the last is a descriptive term, meaning the imperial city; it is where the dairi or kubo resides. This being their mode of using the Chinese character in writing proper names, we have thought it would be best to introduce them; the same remark applies to names of individuals, officers, and indeed every use of the Chinese. A few sentences occurring in the preceding paragraphs will be met with in these, but being embodied in the original, they could not very well be omitted, and the whole is translated as it stands.

Memoir on Smelting Copper.—"The places in this country where the most copper is obtained are Besh-shi in Yo, Nanbu in Aü, and Akita in U; next to these places are Sonsau in U, and Shiöya in Tan; and the poorest are Ginsau and Sheükoku in Sheki, Kitsukaü in Bi, Beïwa in Ki, Kinsan in Sa, Taiya in Yetsu, Taten in So, and some others. From some of these places, there is at times much, and at others little, produced; the mines are sometimes open and sometimes shut. Besides these there is so large a number which produce but little, that they can hardly be enumerated. Now the productive veins have limits, and the branching offsets cease midway; some of them will not repay the outlay; others, the owners are unwilling to dig; and again there are others which are not worked on account of the labor attending them: of all these there are many.—The copper ore sometimes contains both silver and lead, and at others it is pure without any admixture; it is also alloyed with zinc. The rules for smelting are also dissimilar. There is some copper which is wrought by hammering, and some which is cast by fusing; generally speaking, that which contains silver and lead is softer, and is hammered into sheets, or drawn out into wire. That which is alloyed with zinc is very solid and hard, easily fractured if hammered, and unsuited either for sheets or wire; but if the soft and hard be fused together, there is no danger of its fracturing. If lead or tin be intimately blended with it, the alloy is very sonorous, well adapted for mirrors and bells. However, each has its own rules; and if [the reader wishes to read] the rules for quarrying, smelting, &c., they are briefly explained in the following pages.

Sec. I. *Of the ore.*—"All copper localities produce ore accompanied with earth and barren rock. When the mine contains copper ore, its evidence will always be found on the top of the hill, of a reddish black hue, coloring both the earth and stones. It forms a connected vein, either long or short, broad or narrow; either deep or shallow, rich or poor, according as the ore is much or little; for it is the effluence of the copper which steams up and forms it, and the miners diligently examine its aspect in order to judge whether the copper will be much or little, good or bad.

Sec. II. *Of digging the ore.*—"When the appearances on the top of the hill betoken good ore, [the miners] dig several perches into it in a circuitous manner; as they penetrate, setting up posts and joists, and laying boards and rafters upon them, stopping the empty interstices with stones and dirt, in order to prevent the pit caving in. The miners carry a lamp made from a shell, as they work the ore and fill their buckets. The number of days or months required to penetrate ten or twenty perches cannot be determined. Sometimes ore will be, and sometimes it will not be, met with; and when it does occur, the lode will suddenly stop, and again be resumed; at times it will continue on without

faults; there are lodes which grow smaller and narrower, the further they are followed; others suddenly contract, and as suddenly enlarge; some diverge, and others are without any branches. The rock which envelopes the ore varies in its aspect. The barren rock is thrown aside as of no further use. The ore is of many sorts, yellow, black, reddish and gray, brilliant and dull, some of it contains much, and some of it little. Indeed, the nature of the mine is not uniform, nor is it possible to obtain the ore alike in order to average the good and bad. When dug out, the ore is broken to fragments, and the process of selection and throwing away the barren stone is called *kaname* (or examining the ore). Generally, the best ore produces one tenth of copper, and the poorest, one twentieth.

Sec. III. *Of roasting the ore.*—"Whenever ore is roasted, a kiln is built under a shed. Faggots are spread upon the bottom and ore laid upon them; a layer of faggots and one of ore alternately are piled up to the brim. A vent-hole is cut in the bottom of the kiln for the draft to be free. The smoke is so sulphureous as to suffocate one, and the fire cannot be approached. When the fire has burned ten days, and gone out, the whole is cooled and taken out, but the ore has undergone but little change. These are the general outlines (of the mode of roasting).

Sec. IV. *Extracting the coarse metal.*—"Whoever extracts the coarse metal, constructs a wall in a building, and [on one side of it] makes a large furnace, having a trough leading out of it; on the other side of the wall two large bellows are placed. The roasted ore is then put into the furnace upon the coal, and two tall men pull the bellows, while a third, holding a long iron rod, stands before the furnace to separate and level the mass. When the fire has reached its strength, and the liquid metal has risen and filled the furnace, the earthy scoria floats upon the surface, and little by little flows off into the trough; as it flows out, it is suffered to cool, or else water is sprinkled upon it, and it is taken out and thrown aside. When the ore is all melted, more is added and additional coal placed upon it, until the furnace is full of good metal, when the earthy scoria and coals are all pushed off. Water is then sprinkled upon the top of the furnace, to cause the liquid metal to separate from the cold, and form a crust which can be raised up. An iron pole is employed to peel it off and take it away; first sprinkling and peeling, until all is taken off, when there is found at the bottom of the furnace a mass of copper; if, however, the ore is poor, there may be none.

Sec. V. *Of extracting the copper.*—"The rules for calcining the coarse metal, and extracting the copper, are for the most part like those for melting the ore and extracting the coarse metal. But when the furnace is full of liquid metal, the top is luted with clay, leaving a small hole in it in which to put the coal and blast the charge. If there is any scum take it out immediately, and

wait till the whole mass is thoroughly fused; then open the furnace, and entirely remove the ignited coal and earthy slag, after which, wait till the heat has abated a little, and then, sprinkling the surface, take it out in the same manner as when taking out the coarse metal.

"All the operations described above, from quarrying the ore out of its bed to the first making it into pure copper, are done at the mine. The officers' orders are that no copper shall be privately sold, but that it must all be carried to the Riau-kwa foundry; where the superintendents direct the founders to smelt and cast it, then assort the various qualities and affix their corresponding prices. That which is delivered at Nagasaki and Kwashi is from Besh-shi, Akita, and Nambu. That which is brought to market for ordinary purposes of manufacture is all produced from other places besides these three. The number of founders is likewise fixed; they cannot be lightly increased or diminished, lest malpractices should arise. That copper which contains silver, and that which contains zinc, and the pure metal, must not be mixed. There are these two operations carried on in the foundry.

SEC. VI. *The second smelting.*—"Every district which produces copper has it smelted a second time in a foundry furnace. When fused, take off the slag and the coals, and then work the bellows a second time until it is liquified; wait till the heat has abated a little, sprinkle water upon it to concrete it, and then take it out with an iron rod. This is re-smelted copper or fine metal. [The mass] is about a cubit broad, and half a cubit thick, being a little smaller than the bottom of the furnace. The process is for the most part like that of extracting the coarse metal. Generally speaking, about 250 catties can be melted in the furnace at once, and there are three fusings in a day.

SEC. VII. *The third smelting.*—"The twice smelted copper is put into an earthern crucible, placed in the furnace and melted. A tub of hot water is set near at hand and a square wooden pool made, into which the molds are placed; and over them a thick hempen cloth spread. When the copper is melted, the scoria taken off, and the fire reduced, hot water is poured into the pool (not very hot), until it is almost level with the molds; then the smelter, firmly grasping the crucible with a pair of large iron pincers, pours [the metal] into the molds, which are previously sprinkled with warm water lest the mold should crack.* Afterwards, water is sprinkled upon the bars to cool them, and they are taken out with a pair of iron nippers. Each casting produces ten or more bars; they are seven or eight inches long, and

* "If cold water is indiscreetly sprinkled [upon the molds], or if the crucible is cracked, in both cases an explosion will take place; and because the lives of persons are endangered by such an accident, great care should be used to guard against it." Note in the original.

weigh about ten taels (i. e. nearly a pound av.) each. The copper is all poured off in about ten times, and the crucible is fused ten times in a day. In this manner are made the copper bars which are brought to Nagasaki and Kwashi.*

"The above are all the rules for smelting pure copper; there are others for taking the re-smelted copper, fusing and casting it into square, or round, or other shaped molds, as will be presently explained, and these are, in the main, similar to those for making copper bars.

"Copper was first brought to this country by eastern people. According to the Memoir on Copper, the year was between the reigns of Genki and Tenshei. For about a thousand years, the metal from every district was chiefly of the third quality, as they had not learned how to extract the silver; so that they could be called deficient in manipulation. For this is known from the fact, that if broken copper utensils, made in the reign of Tenshei and before him, be smelted, silver can always be extracted from them. The silver used in those days was all obtained from mines. At the end of Tenshei's reign, certain foreign merchants came to Sakai in the country of Shen, and taught the mode of extracting silver to Sumitomo Zhiyusai; this was in the year 1591. In the reign of Tsungching of the [Chinese] Ming dynasty, from that which was produced at Soü-yoü-shei, the furnaces of Tenkoü and Kaimutsu became skillful in extracting the silver, though the mode of operation was different. Teënching reigned the fortieth year after this, in 1631. From Sumitomo Zhiyusai and after, the family has followed the occupation of mining and smelting copper; the fourth in succession was called Sumitomo Tomoyoö, and he discovered a copper mine in the department of Yo (or Yo shiu), while Genroku reigned, which he desired leave to open; it has yielded not less than 7,000,000 catties of copper annually, while it has been constantly worked up to the present time, more than a hundred years. For seven generations past this family has superintended the Raükwa foundry; and because the designation of the foreign merchants was Shiromidzu they have joined the two characters to form Shen their present mark. He who first in this country extracted silver from copper was undoubtedly Sumitomo Zhiyusai, but people generally did not know this fact, and therefore this explanation has been introduced.

Sec. VIII. *Of alloying copper and lead.*—"When silver and zinc are combined with the copper, lead is added and placed on top of the furnace, and the whole mass fused. When the earthy

* Thunberg says the "copper, after being roasted and smelted at the smelting house, is refined and manufactured at Miyako, where also all the coin is struck." Vol. III, page 141. The foundry of Raükwa, mentioned in this account, may be at Miyako, but we have no means of ascertaining.

slag and hot coals are removed, an iron pole is used to take it out by adhesion; its appearance is that of broken tiles, and it is called *awashe kane*, or alloyed copper. Generally there are 8 parts of copper and two of lead; but the lead is according to the quantity of silver, if there is much then more is added, if little the lead is reduced.

Sec. IX. *Of separating the lead and copper.*—"The alloyed copper is put into a Namman furnace (so called because the southern foreigners introduced it; it is built of earth), and coal added by degrees as the bellows is worked. A crooked iron rod is used to stir the metal about in the clay, but it must not be allowed to become melted so as to run. When the lead is fused, it will flow off, carrying the silver in combination with it. If the zinc is also ready to run off, the workman with his iron rod stops and turns it off so that it may not mix with the lead; it usually remains just between the lead and copper. When the lead has all run off (i. e. that combined with the zinc), then scoop the zinc up and take it out; and when both the lead and zinc are separated, sprinkle water and take out the copper; it is called *shibori doü*, pure (*lit.* wrung out) copper. The lead in the hollow place cools and forms a round mass (called *shiyuts shiyo*, or extracted lead); it still combines silver with it, which does not show itself. Truly this process of separation must be regarded as very elegant!

Sec. X. *Sinking the lead to extract the silver.*—"The first thing in cupellating the silver is to construct an ash-furnace; the foundries of Tenkoü and Kaimutsa call it an ash pool, it is made of sifted ashes placed on the earth, having a depression about a cubit wide, and a hollow place in its middle. When the lead is in, coal and fire are put on, and a defense formed of wet ashes like a wall or dyke is built around, leaving a hole in front to work the bellows (as well as to see the state of the fire), on the top of which a cover of a broad tile is closely luted with wet ashes. The bellows is then gradually blown until the fire attains its strength, causing the lead to drop into the ashes, where it forms a mass upon the bottom. The lead is called *ruikasu*, and is afterwards purified from the ashes. The silver floats in the middle as a small round cake, and is called *haibuki gin* or ash-melted silver. Such are the rules for extracting the silver.

Sec. XI. *Supplement of rinsing the scoria of the copper and zinc.*—"The separated copper is of the same quality as the re-smelted; it is melted and made into copper rods, and into ingots for hammers and nippers. That cast into square sheets is used to tile houses, the round is made into cups, the oblong pieces are employed in constructing eave-troughs, and the long rods are for making wire. If the lead and zinc are not completely separated the copper will split and crack when hammered; it is consequent-

ly very important that at the time of smelting it be perfectly purified. Zinc is only used as an alloy in making mirrors and warming stoves and bells; if it is combined in the copper, that metal will not stick to the molds, but when taken out, the engravings and ornaments will be distinct and clean.

SEC. XII. *Of the washing and rinsing.*—"The fragments of copper taken from the refining furnace which adhere to the scoria, and that from the crucible, are beaten in a mortar, sifted and then rinsed in water in order to obtain the copper.

"Written by Mas'tadzuna (or Soü ten-boü) a pupil of Sumitomo Zhiyusai in Raükwa."

When Thunberg accompanied the Dutch embassy to Yédo in 1776, the party after much intreaty were allowed to see the operation of casting the copper bars at Ohosaka, which he thus describes. We introduce it as the testimony of an eye-witness to corroborate the native account.

"The operation of smelting of copper was one day performed particularly for us, and merely on purpose that we might see it, in consequence of the importunate intreaties both of our chief and our conductors. This was done with much greater simplicity than I had imagined. The smelting hut was from twenty to twenty-four feet wide, and a wall like a niche was built up, with a chimney on one side of it. At the bottom of this, and level with the floor, was a hearth, in which the ore, by the assistance of a hand-bellows, had been smelted before our arrival. Directly opposite, on the ground, which was not floored, was dug a hole of an oblong form, and about twelve inches deep. Across this were laid ten square iron bars, barely the breadth of a finger asunder, and all of them with one of their edges upwards. Over these was expanded a piece of sail-cloth, which was pressed down between the bars. Upon this was afterwards poured cold water, which stood about two inches above the cloth. The smelted ore was then taken up out of the hearth, with iron ladles, and poured into the above described mold, so that ten or eleven bars, six inches long, were cast each time. As soon as these were taken out, the fusion was continued, and the water now and then changed. That the copper was thus cast in water, was not known before in Europe, nor that the Japanese copper hence acquires its high color and splendor. At the same time I had the good fortune to receive, through the influence of my friends the interpreters, a present of a box, in which was packed up, not only pure copper cast in the abovementioned manner, but also specimens taken from every process that it had gone through, such as the crude pyrites with its matrix, the produce of the roasting, and of the first and second smelting. * * *

"After this we saw a quantity of cast copper, not only in the abovementioned form of bars, as it is sold to the Dutch and Chi-

nese, but also cast in larger and smaller, round and square, thicker and thinner, pieces, for other purposes, according as they may be wanted for the fabrication of kettles, pans, and other utensils."

The copper exported by the Dutch is, according to Thunberg, packed in long wooden boxes each containing one pecul. A cargo consists of six or seven thousand chests. The bars, he says, "are six inches long, and a finger thick, flat on one side, and convex on the other, and of a fine bright color. Each bar weighs about one third of a pound." One of the bars now lies before us. It is nine inches long, flat on one side and convex on the other, the upper side much blistered, of a dark carmine color, and weighs 11 taels, 3 mace, and 8 candareens, or 15·12 oz. avoirdupois.

ART. XXIV.—*Caricography;* by Prof. C. DEWEY.

(Appendix, continued from vol. vi, 2nd ser., p. 245.)

No. 237. *Carex ignota*, Dew.

Spicis distinctis; spica staminifera unica gracilis longo-pedunculata squamo-bracteata cum squamis oblongis obovatis subobtusis; pistilliferis ternis oblongis laxifloris erectis exserto-pedunculatis foliaceo-bracteatis, inferiore longo-pedunculata; fructibus *tristigmaticis* elliptico-triquetris utrinque teretibus alternis subconico-rostratis ore integris subrecurvis, squama ovata acuta cuspidata membranacea paulo longioribus; culmis foliisque subpubescentibus.

Culm 18–24 inches high, erect, rather slender, triquetrous, leafy towards the root; leaves short and lanceolate, striate; bracts sheathing, leafy, shorter than culm and enclosing the peduncle of the upper pistillate spike; staminate spike single, erect, exserted from the upper sheath, with oblong or obovate obtusish scales; pistillate spikes three oblong, filiform, erect, loose-flowered, the two lower long pedunculate, and all sheathed; stigmas three; fruit elliptic-triquetrous, tapering to both ends, conic-rostrate, slightly recurved at apex, with orifice entire, alternate and smooth; pistillate scale ovate, acute and cuspidate, shorter than the fruit; culm, leaves, and sheaths, slightly pubescent, pale green.

From Louisiana through Dr. Sartwell, and a few years since it came to me from Dr. Hale of the same state. It resembles slightly *C. anceps*, but the fruit is much longer and more conic, and appears a distinct species.

No. 238. *C. vulpina*, L., Schk., No. 23, Tab. C, fig. 10.

Spica decomposita, sæpe ramosa; spicis *distigmaticis* ovatis obtusis coarctatis densis superne staminiferis, interdum sparsis interruptisque; fructibus ovatis apice teretibus subrostratis diver-

gentibus bidentatis margine subscabris, squamam ovatam acutam subpaulo superantibus.

Culm 1–3 feet high, erect, wide-triquetrous and acute on edges, sometimes small and slender and with a few scattered spikelets; leaves lanceolate and rough on the edges, subradical; spike often long and large and more than decompound with densely aggregated spikelets, staminate above; fruit ovate, broadish, tapering into a beak, two-toothed, subscabrous on the margin; stigmas two; pistillate scale ovate acute, narrower and a little shorter than the fruit.

A well known species over Europe, and very different, though resembling our *C. stipata*, Muh.; but it was not detected in our country till a few years since by Mr. Sullivant in Ohio, and later by Dr. Mead and Dr. Vasey in distant localities in Illinois.

No. 239. *C. scabrior*, Sartwell in literis.

Spica composita vel decomposita arcte ramosa, interdum non ramosa; spiculis ovatis parvis dense aggregatis raro bracteatis superne staminiferis; fructibus distigmaticis latis convexis rostratis bidentatis margine perscabris serrulatis, squama ovata acuta vix duplo longioribus; foliis culmisque margine perscabris.

Culm two feet high, erect, stiff, rather slender for its height, triquetrous, very scabrous on the edges, leafy on the culm towards the root; leaves linear, flat, striate, sometimes long as the culm, scabrous on the edges, long acute; spike compound, sometimes interrupted, two inches or more long, and oftener decompound with many dense spikelets on the branches below and dense also towards the apex of the spikelets; stigmas two; fruit broad ovate, convex, rostrate, bidentate, on the margin serrulate; pistillate scale ovate, acute, less than the fruit and about half as long; the bract scale under the spikelets ovate, cuspidate, surpassing the fruit; plant rather dark green.

Found by Dr. Sartwell near Penn Yan some years ago, but not determined till lately; it may possibly be the true *C. vulpinoidea*, Mx., to which has been credited *C. multiflora*, Muh. It differs much from the latter, but is nearer *C. setacea*, Dew., which is clearly distinct from both. It has not been confounded with *C. multiflora*, and the absence of the *setaceous* bracts, as well as other characters, separates it from *C. setacea*. It is far different from *C. vulpina*. L.

No. 240. *C. platyphylla*, Carey.

Spica staminifera unica subclavata brevi-pedunculata cum squamis oblongis acutis, pistilliferis ternis gracilibus paucifloris (3–6) exserte pedunculatis folioso-bracteatis laxifloris erectis; fructibus *tristigmaticis* ovatis utrinque acutis triquetris ore integris apice subrecurvis, squamam ovatam acutam vel aristatam multo superantibus; culmis demum subprostratis, et foliis radicalibus patulis nervosis.

Culm 3–8 inches high, erect, triquetrous, at length nearly prostrate with sheathing leafy bracts shorter than the culm, and with broad radical leaves distinctly three-nerved: staminate spike clubform, short, short-pedunculate, with oblong acute scales; pistillate spikes two, or three often, few and loose-flowered, exsertly pedunculate a little, and a little shorter than the leaf of the bract; stigmas three; fruit ovate triquetrous, *smooth* and nerved, acute at apex and turned slightly one side; pistillate scale ovate, acute or cuspidate, white on edge, shorter than the fruit; leaves pale green.

Open woods over the country, but has been placed under *C. plantaginea* and *C. anceps*. By Muh. both these were blended together, though far different. By Schk. they were only half distinguished, as he placed the wide leafed *C. anceps* under *C. plantaginea*, while he gives a correct figure of the latter on Tab. U, fig. 70, and of the former (*C. anceps*) on Tab. Kkkk, fig. 195, and of the narrow leafed *C. anceps* on Tab. Fff, fig. 128, as they have been for years understood. These two need to be separated; and I propose to call the wide leafed *C. anceps*, *C. patulifolia*, leaving to the narrow leafed its proper name as described by Schk., and not confounding it with *C. conoidea*, Muh., the *C. blanda*, Dewey.

C. platyphylla was properly separated by Mr. Carey and published in Prof. Gray's *Botany of the Northern States*, and placed in the section with *C. plantaginea*, Lam., and *C. Careyana*, Dew.

Note.—*C. alopecoidea*, Tuckerman, var. *sparsi-spicata*, Dew., has scattered spikelets, forming a compound spike three inches long, and not an aggregated head of spikelets.

In Washington, Mich.—*Dr. Cooley.*

C. intermedia, Good., is found by Dr. Geo. Vasey in Ringwood, Ill.

C. fœnea, Muh., has been found abundantly by Mr. Olney in Cumberland, R. I.

Art. XXV.—*On the Diurnal Variations in the Declination of the Magnetic Needle, and in the Intensities of the Horizontal and Vertical Magnetic Forces;* by William A. Norton, Professor of Mathematics and Natural Philosophy in Delaware College.

(Continued from p. 226.)

We have seen in a former part of the present paper, that the secondary nocturnal variations of the horizontal magnetic intensity of a place, correspond, in respect to time and direction, with the deviations in the nocturnal loss of temperature from uniformity, and that the cause of these deviations is therefore, in all probability, either identical with or closely related to the cause of the

variations in question. It follows therefore from the conclusions which have just been obtained, that the probable cause of the secondary variations of the horizontal force is to be found in the varying quantities of dew deposited at night; from one hour to another, and from one season to another. It is to be observed, however, that it is not essential that the unequal losses of temperature at night should be attributable entirely to the thermal influence of dew, to enable us to draw this inference. We have seen that the results of observation and experiment conduct us to the conclusion that the tendency of this influence is to produce the inequalities which have been under consideration. This furnishes sufficient ground for the inference; but if the entire amount of the inequalities of the decrease of temperature be not due to this influence, there is room to doubt whether the secondary variations of the horizontal force might not be attributable to the action of the other unknown cause or causes tending to produce unequal variations of temperature at night. In this event also, in estimating the effect of the dew upon the horizontal force, we could not be positively certain that the entire variations of temperature at night were attended by corresponding variations in the amount of heat in the stratum of variable temperature below the earth's surface: unless, at least, it should be admitted that the unknown cause must consist in some relation or phenomenon external to this stratum.

Having thus arrived, inductively, at the probable cause of the secondary nocturnal variations of the horizontal force, let us see how it applies itself to the detailed explanation of these variations. It is abundantly evident, from what has gone before, that the continual accumulation of dew, or condensed vapor, at the earth's surface from evening till morning, must tend to diminish the rate of decrease of the horizontal force; and that the increase in the quantity of dew that falls, from hour to hour, must tend to make this diminution greater and greater, and that it is not improbable that towards morning the effect of the increased quantities of dew may prevail over the effect of the loss of heat, and thus that the horizontal force may begin to increase. (See the July No. of this Journal, p. 40, figs. 1 to 5.) The actual variations of the horizontal force, it will be observed, are the result of two antagonistic causes: the tendency of the uniform loss of heat, from radiation, is to make the horizontal force decrease uniformly during the night; the tendency of the dew is to augment this force, but it acts unequally, producing the greatest effect towards morning, when it ordinarily prevails over the other cause. The dew tends to augment the horizontal force in two ways; by furnishing a certain amount of heat to the earth, and thus diminishing the loss of heat, and by adding to the amount of magnetic matter at the earth's surface. The joint effect of these two

opposing causes should be different in different seasons. From the vernal to the autumnal equinox, the dew is less in amount and the nocturnal fall of temperature is greater, and therefore the height of the morning maximum of horizontal force ought to be less, than from the autumnal to the vernal equinox—a conclusion which accords with fact. (See as above.)

To obtain a theoretical estimate of the relative height of this maximum in these two periods, we have only to seek for the amount of the diminution of the horizontal force during the night, that would result from radiation alone, and then allow for the proportionate effect of the dew, both thermal and directly magnetic. Now it appears, on an examination of the curves of the daily variation of horizontal force, that the diminution of the horizontal force at sundown, which must be chiefly due to radiation, is about one-half of one of the division-spaces in the diagram: according to this, the tendency of the radiation is to diminish the horizontal force, during a night of twelve hours, (from 5 P. M. to 5 A. M.,) the amount of six of these spaces. We have obtained for the proportionate amounts of dew on a single night during the two periods above mentioned $0^{in}\cdot024$, and $0^{in}\cdot04$. These numbers bear to each other the ratio of 6 to 10, or 3 to 5. Now, the curves of the daily variations of the horizontal force for the middle quarters of the year show that during these periods the morning maximum is about one division and a half below the evening maximum. According to this the tendency of the entire effect of the dew must then be to increase the horizontal force $4\frac{1}{2}$ divisions. Increasing this number in the proportion of 10 to 6, we have for the effect of dew during the first and last quarters of the civil year, (or from the autumnal to the vernal equinox,) $7\frac{1}{2}$ divisions: which makes the morning $1\frac{1}{2}$ divisions higher than the evening maximum. This is a close approximation to the actual state of the case, as shown by the curves. The effect of the dew is partly attributable to the heat evolved, diminishing the loss of heat and of surface temperature, and partly to the direct magnetic action of the dew. If the continual diminution in the loss of temperature at night, from hour to hour, could be partially attributed to any other external cause, the effect of the dew in augmenting the horizontal force would only have to be diminished in the same proportion.

It remains for us now to consider the secondary variations of the horizontal force which occur during the forenoon. We have already seen that the horizontal force decreases from 4 or 5 A. M. to 10 A. M., although the temperature increases; and have attributed this fact to the evaporation of the dew and rain that fall during the night. This explanation involves the supposition that, in the average of months, the amount of the evaporation is greatest early in the day. That this is really the case may be

inferred from the following considerations. In the first place the dew deposited at night is evaporated during the morning hours. In the next place the greater part of the evaporation of the rain that falls during the night and the latter part of the day, will have place during the forenoon of the following day; except when the rain is a heavy one, or the ground was previously quite wet, in which case, in the same state of the sky, the evaporation will be most abundant during the warmest part of the day. The average amount of rain that falls during a single night is considerably greater than the average amount of dew. The average quantities of rain that fell during the different quarters of the year, at Philadelphia, according to the observations for the years 1842–3–4, vary from five inches to sixteen inches, which is equivalent to from $0^{in}{\cdot}03$ to $0^{in}{\cdot}09$ (nearly) in a single night. It is to be expected, therefore, that, if the morning decrease of the horizontal force be really attributable to evaporation, there will be variations in the amount of the decrease connected with the variations in the quantity of rain. That such a connection really exists will be manifest on consulting the following table, showing the quantities of rain, and the average decrease of the horizontal force for the different quarters of the years 1842–3–4.

	1842.		1843.		1844.	
	Rain.	Force.	Rain.	Force.	Rain.	Force.
1st Quarter,	6·3	3			7·3	2
2d "	10·6	4	10·3	3·25	5·2	2·5
3d "	11·4	5·75	15·7	4·75	10·8	3·5
4th "	7·8	3·75	8·7	2	8	3

The following table of averages will make the connection in question still more evident.

	Rain.	Ratios.	Force.	Ratios.
1st Quarter, ...	6·8		2·5	
2d "	8·7	1·3	3·25	1·28
3d "	12·6	1·45	4·66	1·43
4th "	8·2	·65	2·92	·63

The correspondence between the ratios is remarkably close, and would seem to indicate that, in the average of years, the diminution of the horizontal force in the morning is mainly due to the evaporation of the water that has fallen in rain and is but slightly effected by the variations in the rise of temperature, and in the amount of dew.

Diurnal Variations of the Vertical Magnetic Intensity.

According to our general theory the vertical intensity is proportional to the difference of temperature of two places situated at equal distances to the north and south of the station of the needle, and on a line perpendicular to the isogeothermal line. We have then to enquire whether the diurnal variations of the vertical intensity are proportional to the diurnal variations of the difference

of temperature of two places thus situated. The theory strictly requires that the difference between the average temperatures, at any time, of the ground near the surface should be taken, but there is little reason to doubt that the laws of the variations of this difference, at any one season, will be very nearly the same as of the variations of the difference of surface temperatures. Whatever errors may result from taking the latter difference instead of the former will probably be simply errors of quantity.

Although I am not in possession of the precise data demanded for a minute prosecution of the present inquiry, still the meteorological observations made at Philadelphia and Washington will furnish differences of temperature, which will doubtless, in the average for weeks and months, differ little from the differences demanded. Let us then compare the curves showing the mean diurnal variations of the vertical intensity for the different quarters of any one year, 1841 for example, with the curves showing the mean diurnal variations of the difference of temperature of Washington and Philadelphia for the same periods of time. (See figs. 13 to 20.) On examining these curves it will be seen that the maximum of vertical intensity, at all seasons of the year, is not far from the hour of maximum daily temperature (between noon and 4 P. M.) and the minimum toward midnight, and that the same is true of the differences of temperature. The curves of vertical intensity, for the other years, conform to the same general law, and the calculations of difference of temperature, so far as

Curves showing the Mean Diurnal Variations of the Vertical Force, for quarters of years.

Fig. 13. Jan., Feb. and March, 1842.

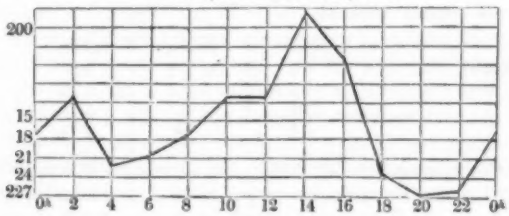
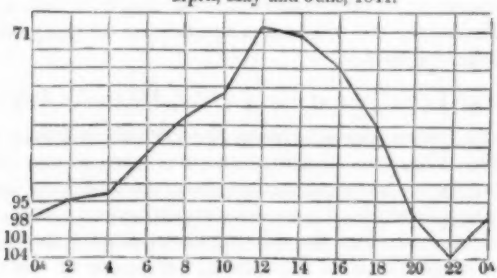


Fig 14. April, May and June, 1841.



Curves showing the Mean Diurnal Variations of the Vertical Force, for quarters of years.

Fig. 15. July, Aug. and Sept., 1841.

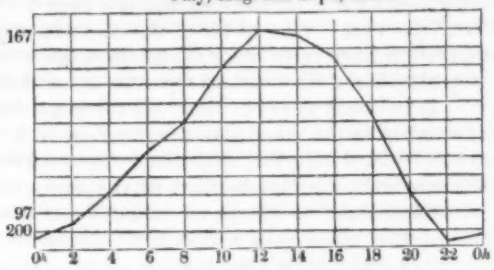
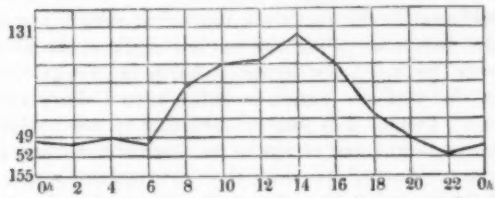


Fig. 16. Oct., Nov. and Dec., 1841.



One division of magnetometer scale = ·000033 vertical force.—Increase of numbers corresponds to decrease of force.

Curves showing the Mean Diurnal Variations of the Difference between the Temperatures of Philadelphia and Washington, for quarters of years.

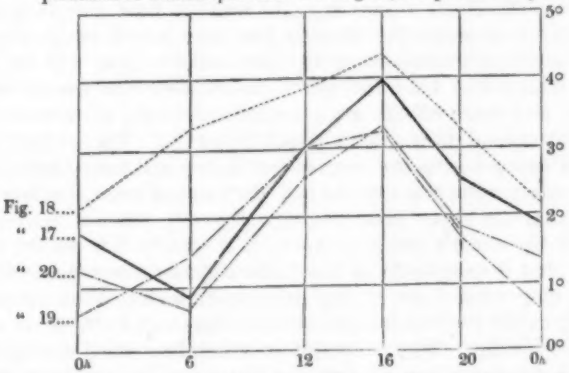


Fig. 17, Jan., Feb. and March, 1842.—Fig. 18, April, May and June, 1841.—Fig. 19, July, Aug. and Sept., 1841.—Fig. 20, Oct., Nov. and Dec., 1841.

they have been carried, serve only to confirm the conclusion that it is a general law that the difference of temperature, like the vertical intensity, is greatest between the hours of noon and 4 P. M., and least about midnight. I conclude, therefore, that the diurnal variations of the vertical intensity must be at least approximately proportional to the diurnal variations of difference of temperature.

If now we compare the curves of vertical intensity for the different quarters of the year 1841, and other years, we find that the variations are generally less for the first and last than for the other two quarters of the year. But, so far as the calculations of difference of temperature have been made, there does not appear to be an equal proportionate difference in the curves of difference of temperature. It is barely possible that this apparent discrepancy may be attributable to the fact that the data are not precisely those which the theory calls for, and that the variations of the vertical force are really the joint effect of the variations of the difference of temperature of all places situated on lines drawn through the station of the needle and at equal distances from this station; but, in all probability the principal cause is to be sought elsewhere. The first inquiry that naturally arises is whether it may not be found in the fact that, instead of taking the difference between the temperatures at the earth's surface, we should take the difference between the average temperatures of the stratum just below the surface, which is subject to a daily variation of temperature. In fact it is easy to see that if we make this correction, the vertical force ought to be less for the same difference of temperature, during the cold than during the warm months; for, the daily variation of temperature being then less, the stratum of sensible daily variation of temperature will be of less thickness. The freezing and thawing which take place in the colder months will also have the effect to diminish this thickness; since when the earth freezes at night sensible heat will be given out, which will make the cooling less than it otherwise would be, and when it thaws during the day sensible heat will be absorbed, which will have the effect to diminish the rise of temperature, and these effects are not confined to the surface of the earth, but extend to a certain depth below it. The rising and falling of vapor during the twenty-four hours will have little or no sensible effect upon the intensity of the vertical force, (unless we suppose that the vapor acts magnetically only when it is in contact with the earth's surface,) since it is chiefly the matter at a distance that is concerned in the vertical action upon the needle, and the tangential force of any particle of matter thus situated will be sensibly vertical for considerable distances both above and below the needle. The evaporation which has place during the day, and the deposition of dew during the night can have then (except upon the above supposition) little or no sensible effect upon the intensity of the vertical force, in any other way than by the heat evolved and absorbed; and this has already been tacitly allowed for, for the actual difference of temperature depends upon the deposition of dew and the evaporation, as well as upon the heating power of the sun and the radiation into space and the atmosphere.

Whether the variations in the thickness of the stratum of daily variations of temperature are sufficient to make the discrepancy above noticed, entirely disappear, must be left for future consideration. In fact, it will doubtless be necessary to have recourse to direct observations before this question can be definitively settled, and a complete explanation of all the details of the variations of the vertical intensity made out with certainty.

A farther investigation reveals the existence of other small discrepancies. These are exhibited to the eye in figs. 21 to 24,

Curves of Mean Diurnal Variations of Vertical Force and Difference of Temperature.

Fig. 21. Jan., Feb. and March, 1842.

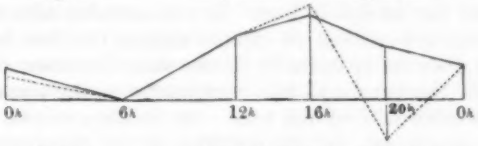


Fig. 22. April, May and June, 1841.

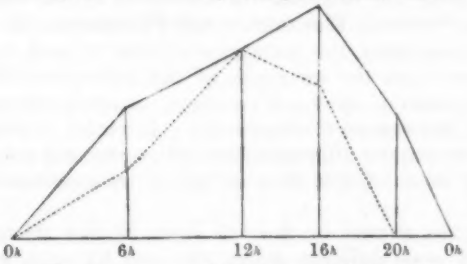


Fig. 23. July, Aug. and Sept., 1841.

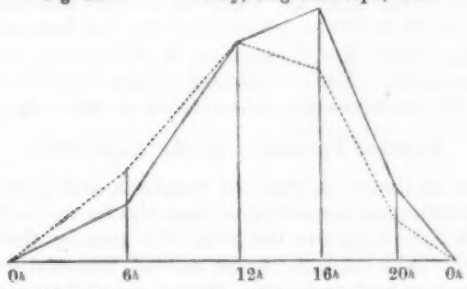
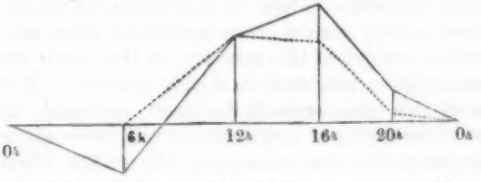


Fig. 24. Oct., Nov. and Dec., 1841.



in which the dotted lines represent the actual variations of the vertical force, and the full lines the variations as deduced from the theory that they are proportional to the variations of the difference of temperature. On examining these figures it will be seen that there is some cause in operation, making the vertical force to decrease more rapidly in the afternoon until 8 P. M., than the difference of temperature, and to decrease less rapidly or to increase from 8 P. M. to midnight. It will be seen also that in the Spring the vertical force increases less rapidly than the difference of temperature during the latter part of the night, and more rapidly during the forenoon; and that during the latter half of the year the reverse is true. It is observable also that these discrepancies are greatest in amount during the first half of the year; that they lie continually in the same direction during the first half of the year, and also continually in the same direction during the other half of the year. As to their origin, they may be purely accidental, for the locality, or for the time; or they may arise from the fact that the variations of the difference of temperature between Washington and Philadelphia do not represent with exactness the variations of the vertical force, since these depend upon the variations of the differences of temperature of all points of the earth's surface, situated within a certain distance of the station of the needle. It would, at all events, be premature to enquire after some secondary physical cause tending to produce these effects, after so partial an examination of the facts.

The curves shown by the full lines in figs. 21 to 24, were constructed upon different scales, obtained by assuming that, for each quarter of the year, the variation of the differences of temperature from 0^h to 12^h be represented by the line which represents in figs. 13 to 16, the variation of the vertical force during the same interval. The coincidence of the full and dotted lines at 0^h and 12^h is a necessary consequence of this assumption.

Diurnal Variations of the Declination.

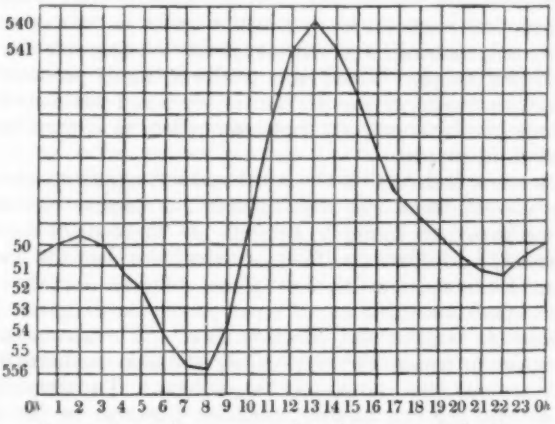
The general theory is, that the needle is nearly perpendicular to the isogeothermal line—that is, that the mean position of the needle is at right angles to the ideal line passing through those places which have the same mean annual temperature. But, in general, the true and mean temperature are different to a certain depth in the ground. There is a stratum of about 60 feet in depth which slowly varies in temperature from one season to another, and a portion of this stratum, of the depth of some three feet, which varies in temperature during the day. If we consider the action of this latter stratum by itself, agreeably to our general theory, its tendency at any moment will be to place the needle at right angles to the line connecting the points where the aver-

age temperature of this stratum is the same. But we have seen in the course of the present investigation, that the magnetic action of the stratum subject to daily variation of temperature, is not proportional to the temperature simply,—that it is dependent upon the evaporation of moisture and the deposition of dew. Whatever may be our explanation of the effect of dew and evaporation, the diurnal variations of the magnetic force of a particle at any place may be regarded with but little probable error, as proportional to the diurnal variations of the horizontal magnetic force there; and the tendency of these variations will be to give the needle an oscillatory movement corresponding to the continually shifting line traced through the points where that portion of the horizontal force which is due to the action of the daily stratum is the same. For the tendency of the magnetic action of this stratum, at any moment, will be to set the needle at right angles to this line; which may be regarded as identical with the line of equal molecular magnetic force.

Having presented these theoretical considerations, let us glance at some of the results of observation. Fig. 25 shows the mean

Curve showing the Mean Diurnal Variations of the Declination, for the year 1844.*

Fig. 25.



Increase of numbers corresponds to decrease of declination.

diurnal variations of the declination, for the year 1844. The curves for the different quarters of the year are of the same form, and agree also with the curve for the year, or very nearly so, in

* The observations of declination, (and the same is true of the observations of horizontal force and vertical force,) were made about 20m. after the Observatory hours, but as our inquiries mainly relate to the laws of the variations, this fact may be disregarded without material error.

the positions of the maxima and minima. If fig. 25 be compared with the curve of the mean daily variation of the horizontal force, (see fig. 3, p. 40, in the July number of this Journal,) it will be observed that the maxima and minima of the former fall nearly midway between the maxima and minima of the latter. Thus, the morning maximum of the horizontal force is at 5 A. M., and the minimum at 10 A. M.—and the morning minimum of declination is from 7 to 8 A. M.: again, the evening maximum of horizontal force is at about 3 P. M., and the principal maximum of declination is at 1 P. M., nearly midway between this and the morning minimum of horizontal force (at 10 A. M). The morning maximum of declination (at 2 A. M.) is also nearly midway between the evening minimum of horizontal force (about midnight), and the morning maximum of the same (at 5 A. M). There is a small deviation from this general law in the case of the evening minimum of declination, which occurs some two hours later than the middle point of time between the evening maximum and minimum of horizontal force. Besides these relations between the maxima and minima of the two curves, it may be seen that there are points of inflexion in the curves of the horizontal force near the epochs of the maxima and minima of the declination; and accordingly that when the curve of the horizontal force is concave upwards the declination (westerly) is increasing, and when it is convex upwards the declination is decreasing. These facts render it highly probable that the diurnal variations of the horizontal force and declination are linked together by some physical connection, as theory has already led us to suppose.

Let us see whether this theory, besides suggesting the fact of such a connection, can also explain the precise connection which we have now found to subsist. If we recur to the principles already laid down (p. 359), we shall see that the inquiry before us leads us, in the first place, to seek for the daily changes of position in the line of equal molecular magnetic force. If we were to neglect the effect of dew and evaporation, the line in question would be very nearly the true isothermal line passing through the station of the needle. To simplify the matter we will for the present, consider the two as the same. Now take some point (B), to the east of the station (A) of the needle, situated on the isothermal line traced through A at 5 A. M., about the time of minimum temperature: an hour later these two points would not be on the same isothermal line, for the increase of temperature at B would be greater than at A. (See curve of daily variation of temperature.) The isothermal line through A would therefore be directed to the north of B. It is obvious that this motion of the isothermal line toward the north, to the east of the station A, will continue until the increment of tempera-

ture at B, in any short interval of time, becomes the same as at A. This will happen at the hour of the most rapid rise of temperature, or about 9 A. M. After this the hourly increment of temperature will be less for B than for A, and the same portion of the isothermal line will move southward. This southerly movement will continue beyond the time of maximum temperature (3 P. M. at Philadelphia), and until the fall of temperature at B becomes less rapid than at A. This will happen about 7 P. M. It is manifest, from the concave form of the curve of daily variation of temperature, during the night, that after this the decrease of temperature at B will be continually less than at A, and therefore that the isothermal line will move northward, to the east of station A, and southward to the west of it. This motion will continue until 5 A. M.; and beyond this, as we have already seen, until towards 9 A. M. In obtaining these results, we have taken it for granted that the law and rate of the mean daily variation of temperature is the same at B as at A. This doubtless is not strictly true, and therefore the epochs of maximum and minimum of declination should be somewhat different from the times above specified. If we neglect this difference, it appears, that on the supposition which has been made, the needle would move toward the east from 9 A. M. to 7 P. M., and toward the west from 7 P. M. to 9 A. M. The actual state of things differs from this in two or three points; during the last half of this period of westerly movement, or nearly so, there is actually an easterly movement, and during the first half of this period of easterly movement there is actually a westerly movement; and the evening minimum occurs generally some two or three hours later, (about 10 P. M.) These discrepancies, (with the exception of the last, which is comparatively trifling,) disappear if we compare the curve of declination (fig. 25) with that of horizontal force (fig. 3), instead of that of temperature, as we should do. If this be done, it is found, as we have already seen, that the points of maximum variation of the horizontal force, or of inflexion in the curve, fall at the epochs of the maximum and minimum of declination.

To understand the movements, in detail, of the line of equal surface magnetic action, upon which the daily horizontal movements of the needle depend, we have only to compare the change of the horizontal force during the hour following the time considered, with the change that occurs an hour later during the same interval of one hour; for the latter is the change that occurs at a place an hour to the east of the station of the needle, cotemporaneously with the change at the station itself. When these two changes are equal the line in question is stationary. When they are both decrements, if the first is greater than the second, as from 8 A. M. to 10 A. M., the line rises, to the east of the station, and the needle moves westwardly; but if it is less, as from 6 A. M.

to 8 A. M., the line moves towards the south and the needle eastwardly. When the changes are both increments, if the first is less than the second, as from 10 A. M. to 1 P. M., the line rises and the needle moves toward the west; but if it is greater than the second, as from 1 P. M. to 4 P. M., the line falls back, or toward the south, and the needle moves towards the east. When the first change is a decrement and the second an increment, as at about 10 A. M. and toward midnight, the line rises and the motion of the needle is toward the west; and when the first is an increment and the second a decrement, as near 3 P. M. and 5 A. M., it falls and the needle moves eastward. It appears therefore that the needle should move toward the west when the curve of the horizontal force is concave upward, and toward the east when the same curve is convex upward. The westerly movement should then be from 8 A. M. to 1 P. M., and from 7 or 8 P. M. to 2 or 3 A. M.; and the easterly movement from 1 P. M. to 7 or 8 P. M., and from 2 or 3 A. M. to 8 A. M. These results accord with observation, with the single exception, that the time of minimum declination is generally about two hours later than 8 P. M.

If we compare the curves of horizontal force for the different quarters of the year, we find that, while the points of maxima and minima, as well as the points of inflexion, are pretty nearly the same for all, the curvatures are in general greater for the two middle than for the first and last quarters of the year, and therefore the daily changes of declination should be greater toward the middle than toward the beginning or end of the year—a result which accords with fact. There appears, however, to be generally a more rapid variation of the horizontal force toward midnight, during the cold than during the warm months; which must be attended with corresponding differences in the small nocturnal increase of declination. This result seems also to be in accordance with fact; but it would be premature to attempt the detailed explanation of such minute differences among the variations, from a limited series of observations made only at the station of the needle. A similar remark may be made with respect to certain small discrepancies which may be observed, between theory and fact, in relation to the relative amounts of the variations at the same hour in the different quarters of any one individual year. A theory which furnishes a sufficient explanation of all the laws deducible from the observations, cannot reasonably be rejected on the score of small discrepancies in quantity, when the observations are much less extended than the theory calls for. The precise movements of the line of equal magnetic action of the surface stratum upon which the motion of the needle depends, can only be ascertained with certainty by instituting special observations at a variety of places in every direction and at various distances from the station of the needle. The

foregoing results have been obtained by taking it for granted that the changes of the molecular magnetic intensity are the same at the same hour of local time all around the station of the needle as at the station itself; which is doubtless not strictly true.

It remains for us now to enquire into the amount of the actual daily angular movement of the line of equal magnetic action, and into the intensity of the disturbing force necessary to the production of the amount of movement of the needle which actually occurs. Let us, in the first place, regard this line as identical with the true isothermal line, and suppose B to be a place situated on this line at 5 A. M.* (or thereabouts), and one hour, say, to the east of the station A. By 9 A. M. the rise of temperature at B will be as much as 2°, on the average, greater than at A, and therefore the isothermal line through A will now pass through a point (C), to the north of B, where the temperature is 2° less than at B. In the present discussion the station A is Philadelphia, and it appears from an examination of the differences of temperature at various hours during the day, between Washington and Philadelphia, used in the discussion of the vertical force, that the difference of latitude of B and C is about equal to the difference of latitude of Washington and Philadelphia, or about 1°. Taking this result and conceiving the isothermal line to be an arc of a great circle, we find, by an easy calculation, the displacement of this line from 5 A. M. to 9 A. M. to be about $3\frac{3}{4}$°. The actual isothermal line, at 9 A. M., will really lie a little to the north (as far as C) of the great circle taken for it, since the variation of temperature about 9 A. M. is nearly uniform. This angle ($3\frac{3}{4}$°) is, however, only a part of the daily angular movement of the isothermal line toward the north, to the east of A, since, as we have already seen (p. 361), this movement begins about 7 P. M. and continues until 8 or 9 A. M. The whole movement cannot be less than 5°. This calculation proceeds upon the supposition that the daily variation of temperature at B is the same as at A, but as a matter of fact the change is somewhat greater for A than for B; since, as we have seen, the difference of temperature of Washington and Philadelphia increases during the forenoon, and A is south and west of B. This will have the effect to diminish the rise of the line of equal magnetic force, from 5 A. M. to 9 A. M., (possibly to 2°); but, as the fall of temperature will be more rapid after 4 P. M., at A than at B, the westerly movement will begin earlier in the evening and attain to a greater amount by 5 A. M. than upon the supposition made above. We may lay it down then as highly probable that the displacement of the line in question cannot be less than 3°.

* The time considered in this connection is the local time at the station A of the needle.

If now we take the line of equal magnetic action, as it has been accurately defined, by its relations to the horizontal force instead of the temperature, we have to consider the amount of the variation of the horizontal force from the minimum at 10 A. M. to the time of greatest hourly variation, at 1 P. M., and enquire how far to the north of B we must go to obtain a horizontal force as much less than that at B as that at B is greater than that at A. But we here meet with a difficulty, inasmuch as the horizontal forces, so called, at B and C (to the north of B), to be compared, are really only the portions of the entire horizontal force, which are due to the action of the variable stratum. The difference between these forces is very much less than that which subsists between the actual horizontal directive forces acting upon the needle, but how much less we have no means as yet of ascertaining with any certainty. For this purpose we must know the proportion which the force of the variable stratum bears to that of the whole magnetic stratum.

Conjectures might be made as to the probable value of the proportion between these forces, but without attempting to enter upon such uncertain ground, I will content myself with remarking that no proportion which, in the light of the investigations of this and the previous paper, seems probable, gives movements of the line of equal surface magnetic force materially less than those of the isothermal line, above determined.

As to the question of the intensity of the disturbing force which produces the diurnal variations of declination, it is, in the first place to be observed, that that portion of the horizontal force, which is due to the action of the variable stratum, is entirely effective in displacing the needle in a direction toward the perpendicular to the line of equal magnetic action of this stratum. Now it appears, upon calculation, that this force must be as much as thirty times its daily variation, in the summer, to produce upon the supposition of a displacement of this line to the amount of 6°, a change of declination amounting to 12′.

ART. XXVI.—*Chemical Examination of the Water of the Tuscarora Sour Spring, and of some other Mineral Waters of Western Canada;* by T. S. HUNT, Chemist and Mineralogist to the Geological Commission of Canada.

IN the autumn of 1847, I visited in the discharge of my duties, a portion of the province which lies to the west of Lake Ontario, and while there, collected several mineral waters, some of which have proved of unusual interest. The results of my examinations appear in our report presented to his excellency the Earl of Elgin, Governor-general of the Province, on the 1st of

May, 1849; from this report the subjoined analyses are taken. Among the waters is the Tuscarora Sour Spring, to which I have already alluded, in a paper read before the Meeting of the American Association for the Promotion of Science, at its session in Philadelphia, in Sept., 1848, and since published in this Journal. It is situated in the Indian Reserve, in the County of Wentworth, about nine miles south of Brantford, and three miles south of the bank of the Grand River. The limestone rock of the region belongs to that formation which is designated by the geologists of New York, as the Onondaga Salt Group. The country for some distance around is thickly wooded; but in the immediate vicinity of the spring is a small clearing, upon a rising ground, on one side of which is the spring, in an enclosure some eight or ten rods square. In the centre of this, is a hillock six or eight feet high, made up of the gnarled roots of a pine now partially decayed. The whole enclosure is covered with crumbling rotten wood, and resembles a tan-heap; upon digging down eighteen inches, the same material was found, apparently derived from the crumbling away of the trunk of the once huge pine, whose roots now occupy the centre of the enclosure. The whole soil, if it may be thus designated, is saturated with acid water, and the mold at the top of the hillock, as well as without the enclosure, is strongly acid. Near the confines of this region, but in soil still quite sour to the taste, several plants were observed growing. They were the sheep's sorrel (*Rumex acetosella*), the wild strawberry (*Fragaria virginiana*), two species of *Rubus*, the red raspberry (*R. strigosus*) and *R. canadensis*, besides several mosses, and a fern. The more acid parts were devoid of all vegetation.

The principal spring is at the east side of the stump, and has a round basin about eight feet in diameter and four to five feet deep; the bottom is soft mud. At the time of my visit (Oct. 18th) it was filled to within a foot of the brim; and as the guide assured me, unusually full, much fuller indeed than it had been five days previous, although no rain had fallen in the interval. There is no visible outlet to the basin; at the centre a constant ebullition is going on from the evolution of small bubbles of gas, which is found on examination to be carburetted hydrogen. The water is slightly turbid and brownish-colored, apparently from the surrounding decayed wood, which indeed forms the sides of the basin. It is strongly acid and styptic to the taste, and at the same time decidedly sulphurous; a bright silver coin is readily blackened by the water, and the odor of sulphuretted hydrogen is perceived for some distance round the place.

Within a few feet of this, was another smaller basin, two feet in diameter, and having about one foot of water in it; this was evolving gas more copiously than the other, and was somewhat more sulphurous to the taste, although not more acid. In other

parts of the enclosure were three or four smaller cavities partly filled with a water more or less acid, and evolving a small quantity of gas. The temperature of the larger spring was 56° F., that of the smaller one 56° near the surface, but on burying the thermometer in the soft mud at the bottom it rose to 60·5°.

A large glass jar was filled with water, and to three bottles into which a solution of arsenic had been previously introduced, were added thirty cubic inches of water; these were then carefully sealed and transported to the laboratory at Montreal.

Examination of the Water.—The specific gravity was found to be 1·005583. A solution of nitrate of silver did not sensibly affect it, shewing the absence of chlorine, but salts of baryta produced at once a copious precipitate insoluble in any acid, indicating that the acid present in the water was the sulphuric; the usual tests applied to the recent water shewed the iron to be in a state of proto-salt, a condition indeed necessarily connected with the presence of sulphuretted hydrogen. When concentrated by evaporation with the addition of a little nitric acid, ammonia gave a copious red-brown precipitate, a portion of organic matter in the liquid interfered with the perfect precipitation of the iron, and hydro-sulphuret of ammonia was consequently added at the same time. The precipitate thus obtained after being thoroughly washed, was dissolved in hydrochloric acid, then boiled with nitric acid, filtered and precipitated by ammonia, with the previous addition of sal-ammoniac, and again filtered. The transparency of the filtrate thus obtained, was not disturbed by hydro-sulphuret of ammonia, indicating the absence of manganese and other metals of this class, including zinc, nickel and cobalt. The precipitate was in part soluble in a solution of potash; the soluble portion was alumina, and the residue peroxyd of iron with a little magnesia. The alumina obtained from the alkaline solution was found to contain traces of phosphoric acid; by dissolving it in hydrochloric acid, adding tartaric acid, ammonia in excess and sulphate of magnesia, a slight granular precipitate of ammonio-magnesian phosphate was obtained.

The filtrate from the original precipitate by hydrosulphuret of ammonia, gave an abundant precipitate of lime, by oxalate of ammonia, and the filtrate from this precipitate yielded, when concentrated and mixed with ammonia and a solution of phosphate of soda, a granular precipitate of phosphate of magnesia and ammonia.

Another portion of this filtrate was evaporated to dryness, and ignited to expel the ammoniacal salts; the soluble salts in the residue were dissolved in water and mixed with a solution of chlorid of barium and excess of caustic baryta, and the mixture heated; to the filtrate from the precipitate thus obtained, were added carbonate of ammonia and excess of caustic ammonia, and the whole

boiled and filtered; the solution was then evaporated to dryness and ignited, when a residue of alkaline chlorids was obtained. The presence of soda was shewn by the peculiar color imparted to the flame of alcohol when it was burned over the salt, and with chlorid of platinum, a bright yellow precipitate of platino-chlorid of potassium was obtained.

In a water so novel in character, we might be led to expect some metal not usually present in mineral springs, and I have accordingly given the details of the qualitative analysis, to shew the measures taken to detect their presence. Arsenic, antimony, tin, lead and copper have all been recently detected in different ferruginous waters of Europe, but the presence of free sulphuretted hydrogen, which is found in the recent water of the present spring, is incompatible with their existence in solution, at least after the small quantity of this gas which it contains, had been decomposed by exposure to the air.

1000 parts of the water yielded—

Sulphuric acid, (SO_3) . . .	4·6350
Potash, ...	·0329
Soda, ...	·0219
Lime, ...	·3192
Magnesia, ...	·0524
Alumina, ...	·1400
Peroxyd of iron, ...	·1915
Phosphoric acid, ...	traces.

Representing the bases as combined with their equivalent of sulphuric acid, we have for the composition of 1000 parts of the water—

Sulphate of potash, ...	·06080
" of soda, ...	·05020
" of lime, ...	·77520
" of magnesia, . . .	·15395
" of iron, (proto.) . . .	·36385
" of alumina, . . .	·46811
Phosphoric acid, ...	traces.
Sulphuric acid, (SHO_4) . . .	4·28952
Water, ...	993·83837
	1000·00000

The quantity of sulphuretted hydrogen present is small, being about one-half of a cubic inch in 200 cubic inches of the water.

The question of the origin of this spring presents such difficulties, that I will not attempt to speculate upon it; the fact that the spring issues directly at the roots of a pine not yet wholly decayed, is evidence that it has not existed for a very long period, at least with its present character; for as it has been remarked, no

vegetable life exists for some distance around the place. Under the ordinary atmospheric influences, I should suppose thirty or forty years would be required to produce the state of decay which the pine exhibits, although both sulphuric acid and the sulphates of iron and alumina are powerful antiseptics, and would considerably retard the progress of decay. Apart from any consideration of this kind, there is not wanting evidence that the waters of the spring have materially changed their character within two or three years. In April, 1846, Professor Croft, of King's College, Toronto, published in the British North American Journal an account of the spring he had obtained from some one who had visited it, with a partial analysis of the water, such as he had been able to execute upon the specimen in his possession. He found in one pint (7680 grains)—

Sulphuric acid, (average of three determinations,)	22·425 grs.
Peroxyd of iron, ...	3·950 "
Magnesia, ...	1·584 "
Lime, ...	3·685 "

No experiments were made to detect the presence of alkalies, nor was alumina sought for; it is probable that the alumina is included in the weight of the peroxyd of iron. The specific gravity was found by Professor Croft to be 1·0038.

For comparison I have reduced Professor Croft's results to the same standard as my own, and give them for 1000 parts; he found the iron as a per-salt, probably from the effect of exposure to the air. I have calculated that obtained by myself, as peroxyd, and added to it the alumina—

	Croft.	Hunt.
Sulphuric acid, ...	2·9069	4·6350
Potash, ...	——	·0329
Soda, ...	——	·0219
Lime, ...	·4798	·3192
Magnesia, ...	·2036	·0524
Peroxyd of iron and alumina,	·5148	·3315

The water examined by Professor Croft contained much less foreign matter than that collected by myself, being in fact more dilute. The sum of the ingredients determined in the former is 4·1051 parts, and in the latter 5·3281 parts in 1000. In the former, the sum of the bases is to the amount of acid, as 412 : 1000, and in the latter as 152 : 1000. The difference in the comparative quantity of sulphuric acid in the two, may be attributed to the dilution by surface water, but the great change in the proportion of the bases to the acid, indicates some change in the internal economy of the spring. The nature and causes of this change with their probable connection with the gypsum deposits, and some of the geological phenomena of the region, have already been discussed in the paper above referred to.

Since the publication of my report, I have received a specimen of a singular water from a spring near Chippewa on the Niagara River, a few miles above the Falls. It is quite as acid to the taste as that of Tuscarora, and contains like it, salts of iron, alumina, lime and magnesia in large quantity; the amount of sulphuretted hydrogen in solution, appears to be very considerable. The soil for some distance around the spring is described as being destitute of vegetation and of a reddish-brown color, which seems probably to be due, like that of the Tuscarora, to decaying vegetable matter which undergoes under these circumstances a somewhat peculiar change.

Charlotteville Sulphur Spring.

This interesting mineral spring is situated a few miles from Port Dover on Lake Erie; it is near the township of Simcoe, and on the third lot of the twelfth range of Charlotteville. It rises near the bank of a small stream which turns a mill. About twelve feet above the level of the creek, is a depression five or six feet deep, forming a natural basin about one rod in width and four rods in length, from N.E. to S.W.; it is oval in form, broader at the S.W. end, near which the spring rises. At the other end, the basin discharges itself by a little rivulet into the adjoining creek. The depth of the water at the time when I visited it, was from one to two feet, and the discharge, as it formed a little cascade before entering the creek, was roughly determined to be about 16 gallons per minute. Its temperature, as observed on the morning of the 19th October, when the air was 26° F., was found to be 45°, while that of the creek was 49°.

The water rises gently through several apertures in the soft mud of the bottom, occasionally accompanied by bubbles of gas. In a still day the surface, with the exception of a small area about the source, is coated with a film of sulphur, which also covers the bottom of the basin. Leaves and sticks near the outlet, are found thickly incrusted with the same substance, or rather with a mixture of sulphur and carbonate of lime. The proprietor of the spring informed me that he was in the habit of gathering the substance thus deposited, and burning it under his bee-hives for the purpose of stupefying the insects while extracting the honey, perhaps the only economical application which can be made of the sulphur itself.

The specific gravity of the water is 1·002712; it is limpid and sparkling, its odor strongly sulphurous, and its taste pungent, with something like sweetness, leaving an impression of warmth in the mouth for some time. When mixed with a solution of chlorid of arsenic, it becomes quite opaque from the precipitation of yellow sulphuret of arsenic. A qualitative examination shewed besides, the presence of chlorids and sulphates, the latter in large quantities; the bases were potash, soda, lime, magnesia,

with traces of alumina and iron; a large portion of the lime and magnesia were not precipitated by boiling. The carbonic acid was determined by the aid of chlorid of calcium and ammonia. For the sulphuretted hydrogen, three bottles were prepared by adding a solution of chlorid of arsenic; to each of these was added 30 cubic inches of the water; the whole was then agitated and allowed to stand a few minutes to permit the escape of carbonic acid, after which the bottles were carefully corked and sealed. This was done at the spring, and the bottles were then transported to the laboratory. When they were opened, the precipitate was collected on carefully weighed filters, dried at 212° F., and weighed. Its purity was determined by its complete solution in ammonia. From the average of these three, the weights closely agreeing, the amount of the sulphuretted hydrogen was calculated to be ·17763 parts to 1000 by weight, or 11·6 cubic inches to 100 cubic inches of the water.

To determine the state in which the sulphur existed, a portion of the water was digested for some time with pure magnesia and then boiled, carefully excluding the air; sulphuretted hydrogen was abundantly evolved, and after a few minutes not a trace of sulphuret could be detected in the liquid. This shews the sulphur to exist as sulphuretted hydrogen, and not as a fixed sulphuret.

The amount of carbonic acid in the water was found to equal ·273 parts in 1000 of the water by weight.

1000 parts of the water gave—

Sulphuric acid,	1·22939
Chlorine,	·06478
Potash,	·02760
Soda,	·20586
Lime,	·64484
Magnesia,	·19436
Carbonic acid,	·27300
Sulphuretted hydrogen,	·17763

These may be combined to give the following composition for 1000 parts:—

Sulphate of potash,	·05103
" of soda,	·47182
" of lime,	1·12670
" of magnesia,	·43510
Chlorid of magnesium,	·08783
Carbonate of lime,	·30500
" of magnesia,	·01798
" of iron,	traces.
Sulphuretted hydrogen,	·17763
Carbonic acid,	·15350
Water,	997·17341
	1000·00000

Amount of solid matter by calculation, 2·49446 parts.

The peculiarity of this water is the unexampled quantity of sulphuretted hydrogen it contains. The strongest of the celebrated Harrowgate Springs yields but 14 cubic inches of sulphuretted hydrogen gas to the gallon, while the Charlotteville contains in the same measure 26·8 cubic inches.

Ancaster Saline Spring.

This spring, which is known to the inhabitants as a Salt Well, is about two miles west of the village of Ancaster, on the land of Mr. Robert Heslop. A well was sunk some years since, to the depth of thirty feet; and during the war of 1813–15, it is said a considerable quantity of salt was manufactured from it in a rude way. The water rises nearly to the surface, and at times a stream is said to flow from it; no outlet is visible, yet the spring, as I was told by the proprietor, fills up rapidly when the water is dipped out. The temperature was found to be the same as that of a neighboring fresh spring, 48° F.; no evolution of gas is perceptible. The water is intensely bitter and saline to the taste; by boiling, a minute quantity of carbonate of lime is deposited, and the liquid contains chlorine, bromine, sulphuric acid, with potassium, sodium, calcium and magnesium. The specific gravity is 1·0291.

1000 parts of water yielded—

Chlorine,	20·2181
Bromine,	·0891
Sulphuric acid, (SO_3)	·4570
Soda,	9·4520
Potash,	·0580
Lime,	5·5916
Magnesia,	2·0990

These may be combined to give the following composition for 1000 parts of the water:—

Chlorid of sodium,	17·82800
" of potassium,	·09200
" of magnesium,	5·07370
" of calcium,	12·80270
Bromid of magnesium,	·10309
Sulphate of lime,	·77690
Water,	963·32361
	1000·00000

Amount of saline matters, 36·67639 parts in 1000.

This water is extraordinary on account of the immense proportion of chlorid of magnesium and calcium which it contains; the sum of these exceeding the amount of common salt. With almost the same amount of solid matter, it contains less than two-

thirds of the quantity of this salt, that is found in sea-water; in this respect it is quite unlike any water hitherto described. For the sake of comparison, I transcribe here Dr. Schweitzer's analysis* of the water of the British Channel. The specific gravity was 1·0274.

In 1000 parts were found—

Chlorid of sodium, ...	27·059
" of potassium, . . .	·766
" of magnesium, . . .	3·666
Bromid of do.	·029
Sulphate of do.	2·296
" of lime, ...	1·406
Carbonate of lime, ...	·033
Traces of iodine and ammoniacal salts,	
Water, ...	964·745
	1000·000

Amount of solid matters, 35·295 parts in 1000.

In a subsequent paper I propose to describe some interesting saline waters from the eastern part of the province, several of which are strongly alkaline, while others in addition to the ingredients generally found in this class of springs, contain salts of barium and strontium.

Montreal, May 15th, 1849.

ART. XXVII.—*On the Decomposition of Aniline by Nitrous Acid;* by T. S. HUNT, of the Geological Commission of Canada.

ALTHOUGH modern researches have shown that several azotized bodies besides those formed by the direct action of ammonia, may under certain circumstances be separated into that substance and a non-azotized body, yet these have either been neutral substances or acids,† and if we except urea, melamine, and some of those amids of the cyanic series, none of the alkaloids have ever yet been found susceptible of such a decomposition. They combine directly with the strongest acids, and resist the action of hydrate of potash, which often evolves new bases from them and even from neutral substances. Piria in his fine memoir on aspar-

* Philos. Mag., July, 1839.

† For some considerations upon the constitution of the azotized bodies, see my remarks on gelatine in this Journal, for January, 1848, p. 74, and September, 1848, p. 259; also an examination into the formula of proteine in the Journal, for January, 1849, p. 109—in which I have attempted to show that these substances are different ammonids of cellulose or dextrine. The analyses of protid and erythroprotid, present also a very close approximation to the formula which I have proposed for proteine.

agine,* has however, pointed out the action of nitric acid containing nitrous acid, as a means of effecting this decomposition in bodies which like that substance had hitherto resisted all agents; and he has shown moreover, that benzamid and butryamid are easily decomposed with the liberation of their respective acids, when a current of nitric oxyd gas is passed through their solutions in nitric acid.

Led by these considerations, I was desirous of submitting to the action of nitrous acid, some of the organic alkaloids, and I selected aniline as the one most convenient for the purpose; Hoffman has shown that the compound of ammonia and phenol is slowly converted into this alkaloid with the elimination of water, when exposed in sealed tubes to a high temperature, and it was to be expected, if this plan of research proved successful, that phenol might be regenerated. Accordingly, some pure aniline obtained by the distillation of indigo with hydrate of potassa and carefully rectified, was dissolved in nitric acid; the saturated solution of the nitrate thus obtained, was mixed with half its volume of nitric acid, sp. gr. 1·25, and three or four volumes of water. The gas evolved by the action of heated nitric acid upon mercury, was then passed through the cold liquid; but no action was perceived, and the orange-red fumes of nitrous acid passed off into the air. The solution was then heated to about 170° F., and again submitted to the action of the nitric oxyd; immediate absorption and a violent action ensued; the whole liquid effervesced from the escape of a colorless, inodorous gas, which had the characters of nitrogen. The liquid, which before was transparent, grew brownish and turbid, and soon an oily film appeared on its surface. When the effervescence had ceased, and the odor of nitrous acid announced that the reaction was complete, the liquid was cooled and agitated with ether; the etherial solution decanted, filtered and evaporated at a gentle heat, left an oily liquid which was nearly equal in volume to the aniline employed.

It was brownish colored, and possessed in the highest degree the peculiar odor of castoreum, with an acrid, caustic taste. It was more dense than water, and soluble to a small extent in that liquid, to which it imparted its own smoky flavor; a splinter of pine wood, moistened with this solution and then dipped in nitric acid, assumed on drying a characteristic blue color, changing to a dark brown. The oil was readily soluble in a solution of caustic potash, and was precipitated unchanged from this solution, by hydrochloric acid. Boiled with a solution of nitrate of silver, the salt was reduced and metallic silver precipitated. The action of strong nitric acid was violent; on boiling the mixture as long as red fumes appeared, an acid was obtained which gave with

* Ann. de Chim. et de Physique, Feb., 1848, and this Journal, Nov., 1848, p. 421.

potash a salt crystallizing in bright yellow needles, very sparingly soluble in water, of an intensely bitter taste and detonating when heated, which was evidently nitrophenisate of potash. These characteristic reactions show beyond a doubt, that the product of this decomposition of aniline is nothing else than phenol or carbolic acid.

The reaction may be represented by the following equation:

1 eq. of aniline and 1 eq. of nitrous acid yield 1 eq. phenol, 2 of nitrogen, and 1 of water.

$$C_6H_7N + NHO_2 = C_6H_6O + N_2 + H_2O.$$

The same process applied to conine $C_8H_{15}N$ should yield a body having the composition of suberone $C_8H_{14}O$, and cotamine $C_{12}H_{13}NO_3$, would probably in like manner give phloretine $C_{12}H_{12}O_4$, or something isomeric with it. The extension of this process to the alkaloids, opens a wide field for investigation, and while it promises many new compounds, may enable us to fix with greater certainty than before, the composition of some of those bodies, and thus disclose relations which will guide us in obtaining artificially many of those important substances.*

As the intervention of nitric acid is objectionable from the difficulty of getting rid of it afterwards, and from its tendency to change many organic substances, I thought, reasoning from the ready decomposition of nitrite of ammonia, that the formation of hyponitrites of the other alkaloids might obviate these objections and yield satisfactory results. In pursuance of this idea, having made a solution of nitrite of silver in boiling water, I added to the still hot liquid, crystallized hydrochlorate of aniline in small successive portions; a precipitation of chlorid of silver immediately appeared, followed after each addition by a violent effervescence, which was due to the evolution of a colorless neutral gas, without doubt nitrogen. Heat was then applied to the solution until the effervescence ceased, and the liquid which had assumed a dark brown color and was covered with an oily film, was treated with ether as in the previous experiment. The etherial solution left upon evaporation, a brownish, adhesive, semifluid substance, which had a strong odor of castoreum, gave with an acid the peculiar blue tint to pine wood, and in all its reactions was identified with the product obtained by the action of nitric oxyd upon the nitrate of aniline.

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* An examination of the action of reducing agents upon the ether of nitrid organic acids, promises to yield some interesting bodies of this class. I mixed an alcoholic solution of nitrobenzoic ether with sulphuric acid, and digested this with zinc until water no longer precipitated any ether from the solution; the alcohol being removed by evaporation at a gentle heat, caustic lime was added and the liquid agitated with ether. The etherial solution left upon evaporation, a heavy oil of a very pungent taste, which was insoluble in water, but dissolved instantly in dilute sulphuric acid; the solution gave by evaporation a white crystalline salt. The quantity of ether operated upon was very small, and I have not since been able to examine farther the product, which appears to be a new alkaloid.

The clear watery solution which had separated from the ether, contained an excess of the nitrite of silver, and gave with a hypochlorite, no evidence of the presence of aniline. The brown color and altered character of the phenol in this experiment, were probably due to the action of the silver salt at a high temperature, which, like the nitrate in similar circumstances, seems to be partially reduced.

The reaction between an alkalamid and a nitrite, is one which results in the production of a new saline genus in place of the nitrite, and the formation of a new amid or an anhydrid amid and water, for I have shown both from the decomposition of the nitrite of ammonia, and from its atomic volume, that gaseous nitrogen may be regarded as an anhydrid amid, represented by NN.* The proper amid of nitrous acid, $(NHO_2, NH_3) - H_2O = N_2H_2O$ is, like carbonic acid, decomposed at the moment of its liberation into an anhydrid and water.

As my official duties call me immediately to the field, I am unable to follow out farther these researches upon the alkaloids, but give my results, hoping that some other person may find time and inclination to pursue the investigation.

Montreal, May 29th, 1849.

ART. XXVIII.—*Description of a Coal Plant supposed to be new;* by CHARLES WHITTLESEY, Esq., of Cleaveland, Ohio.

I SEND herewith the sketch of a coal fossil made by Mr. Jehu Brainard, an artist of this city, which is so singular and elegant as to merit attention, and so far as my limited knowledge of palæontology extends, is not found in the books.

It was first observed by my brother, the Rev. S. H. Whittlesey, about four years ago in the falling roof of the "Chesnut Ridge" coal mine, discovered and opened by us in 1845, and which is situated one mile and a quarter northwest by north from the centre of Tallmadge, Summit County, Ohio.

It is there called "the flower," and has a striking general resemblance to one, but has no botanical resemblance to flowers or other parts of fructification.

If this was originally an *open pod*, whether a flower or not, there should have been seen among several hundred specimens that I have examined, evidences of a circular or oval opening at the edge or apex of the figure. These edges could not always have been pressed together symmetrically so as exactly to cover each other, and if there were two surfaces with interior organs

* See this Journal for May, 1848, p. 408, and for September, 1848, p. 172.

between them, it must have occasionally appeared in that light. But in no instance is there such a separation of the serrated edges, there being but one line across the apex, which is generally straight or slightly curved outward, as in the drawing.

The impression varies in size from a width of five-eighths of an inch by a length of one and a half inches, to a breadth of one and a half, and a length equal to the breadth. The sketch is made from nature and represents the average size and appearance. The very fine but distinct curved lines or striæ, extend without breaks from the tips of the teeth with great regularity, converging to a point at the base, where the stem unites. Its space in the rock is represented by a *very thin* scale of coal, the raised lines on one face of the specimen corresponding to depressed lines on the counterpart, showing it to be a single thickness and not double.

On some of them may be seen fine cross markings like nerves of reticulation, but in the finest specimens these are wanting, and are probably due to wrinkles of compression. The teeth at the edge are not uniform in number. I have counted from eighteen to twenty-six. After much research, no connexion has been observed with any branch or other vegetable, or with each other. The light, slender, but well defined stem is generally wanting. It is never seen longer than represented in the sketch, and seldom more than half an inch in length, where it terminates abruptly, as though it were broken off. There are minute straight lines like fibres in this stem.

I have never seen the fossil elsewhere; but Mr. John Newberry of Cuyahoga Falls, has a specimen from his father's mine, three-fourths of a mile west of "Chestnut Ridge." They exist in the

ordinary bluish gray, soft argillo-silicious shale of the coal series, and in spots are seen in immense numbers, from one to one and a half feet above the coal. The shale is charged with myriads of coal plants, but the only hint I have met with showing any relation between this and other plants, is the fact, that where the *Pecopteris lonchitica* is most abundant, this is seen in the greatest numbers. The Tallmadge mines are in a bed, geologically, at the base of the coal series, and from seventy-five to ninety feet above the conglomerate. One of the sections of the leaf of the *Nœggerathia flabellata* (Hutton and Lindley, plate 29), has an edge marked somewhat like the specimen before us, but it is not straight, the nerves are not as regular and distinct, and its base is tapering and not an oval curve. Although there are thousands of these impressions lying over and across each other, no connexion exists between them as in the Nœggerathia.

The Corpolithus is abundant in the roof of the same mine. I believe the drawing taken with these remarks, will give a full idea of this beautiful medal of ancient vegetation. In searching for a description of it, or some analogue, I have had access to only a part of the numbers of Brongniart.

Cleaveland, Ohio, May 24, 1849.

ART. XXIX.—*Descriptions and Analyses of several American Minerals;* by B. SILLIMAN, Jr., M.D., Professor of Chemistry applied to the Arts in Yale College, and of Medical Chemistry and Toxicology in Louisville University, Ky.

THE results embodied in this article have been lately obtained in the Analytical Laboratory of Yale College by myself, or by my pupils under my immediate supervision and direction.

The research upon the new and interesting species which belong to the family of micas is not complete: but as many months must pass before I can again take up this investigation, it is deemed best to present the results already obtained, that the attention of mineralogists may be directed to them. I will present in a second memoir, such further results as may be determined by the analyses which will be carried forward this winter on the same species. Enough has been done, it is believed, to give definiteness and importance to the subject.

The subjects treated of in this article are as follows:—

I. Description and analyses of several mineral species belonging to the family Mica.

II. Description and analysis of Unionite, a new mineral species.

III. Description and analysis of a species resembling Worthite.

IV. Identity of Sillimanite, Bucholzite and Fibrolite with Kyanite.

V. Analysis of a granular Albite, associated with the corundum of Pennsylvania, and a new analysis of the Indianite of Bournon.

VI. On Boltonite, and Thomson's Bisilicate of Magnesia.

VII. On Nuttallite of Brooke.

I. Species of the Family Mica.

This series of minerals, forming a new and very interesting addition to the mica family, is found associated with the corundum of Pennsylvania, and one or more of the species are probably associated with corundum in every locality where the latter is found. My attention was first called to these minerals by receiving from Dr. J. L. Smith, now in Constantinople, a small portion of a similar mineral which he has called *Emerylite*.* The quantity of this mineral received (only 0·2 gramme), was quite too small to enable me to obtain more than its general characters. As this mica was the means of calling my attention to the others, I will repeat the results of Dr. Smith, with such additional characters as were obtained here.

Emerylite.

This mineral is found associated with the emery from the localities of Asia Minor. It is in brilliant micaceous scales, brittle and inelastic. Color—gray with a tinge of lilac; laminæ easily separable. Hardness 3–3·25. Gravity not satisfactorily determined on so small a quantity. B. B. alone in forceps exfoliates, whitens and emits a very brilliant light, but does not fuse. In close tube yields water which gave a feeble reaction for fluorine. Dissolves in borax to a clear glass, and leaves a siliceous skeleton in salt of phosphorus. The reactions for $\dddot{S}i$ $\ddot{A}l$ Ca Fe and $\dot{K}$, are satisfactory. It is not acted on by strong acids; even by long continued boiling with Nordhausen sulphuric acid very imperfect decomposition was effected.

Fused with carbonate of baryta, a qualitative analysis gave reactions for silica, alumina, peroxyd of iron, lime and potash, with a trace of soda.

I was unable however, with the most exact care, to confirm Dr. Smith's observation of the existence of zirconia—probably a larger portion of the mineral might give a different result.

Dr. Smith gives the following as an approximate result of the constitution of the "*Emerylite*" from several analyses made by himself.

Silica, ...	30·
Alumina, ...	50·
Zirconia, ...	4·
Lime, ...	13·
Oxyd of iron, mang., and potash, .	3·
	100·

* See this Jour., vol. vii, 285.

This analysis gives the ratio $\dddot{Si}^4\,\ddot{Al}^6\,\dot{R}^3 = \dot{R}^3\,\dddot{Si} + 3(\ddot{Al}, \ddot{Zr})^2\,\dddot{Si}$, which gives the following result:—

4 atoms	silica	. .	2309·24 = pr. ct.	31·93
6 "	alumina	. .	3854·00 = "	53·30
3 "	lime	. .	1068·06 = "	14·77
			7231·30	100·00

As however the mineral is hydrous and the analysis confessedly only approximate, this formula cannot be regarded as entirely correct, but it will be found useful in connexion with the results which follow.

The mineral which most closely approaches Smith's Emerylite as far as our observations authorize us to form an opinion, is the next in order and marked in our analyses "A."

A. This mineral is from Village Green, in the town of Aston, Chester Co., Pa., and was sent to me by Mr. L. White Williams, of Westchester, to whom mineralogists are much indebted for bringing to light many interesting things. It is associated with corundum, and occurs in considerable masses, and so much resembling common mica as to have escaped notice until Dr. Smith's observations on "Emerylite" called my attention to the minerals associated with the American corundums. Form like mica, apparently hexagonal, foliæ easily separable but inelastic and brittle. Color white, transparent in thin foliæ. *Lustre*, silvery, vitreous and pearly. Hardness 3·5. Gravity 2·995. B. B. in forceps exfoliates and emits a strong light, fuses on the edges of thin laminæ. In the close tube it is hydrous and gives very feeble traces of fluorine. It behaved with the fluxes like the Turkish mineral. A qualitative analysis showed the presence of silica, alumina, lime, magnesia, soda, a trace of potash and iron, water, and fluorine, the last in very feeble quantity.

The quantitative analysis of this species is still incomplete in its alkaline constituents, which are given by the difference, and the amount of water is probably placed too high.* The analysis was conducted under my direction, by my pupil, Mr. Wm. J. Crawe. Three analyses gave him as follows:—

	I.	II.	III.	Oxygen.	
$\dddot{Si}$	32·311	31·060	31·261	16·24 =	4
$\ddot{Al}$	49·243	51·199	51·603	23·74	6
$\dot{Ca}$	10·663	9·239	10·146		
$\dot{Mg}$	·298	·283	·499	3·42	1
Na and $\dot{K}$†	2·215	2·969	1·221		
$\ddot{H}$	5·270	5·270	5·270	4·72	1
	100·000	100·000	100·000		

* The mean of two determinations. † By the difference.

It is obvious that this is very nearly the true constitution of the mineral; the following formula corresponds very closely with the analytical results, viz.:

$$\dot{R}^3\ddot{S}i^4\ddot{A}l^6+\dot{H}^3=(\dot{C}a\,\dot{N}a\,\dot{M}g)^3\ddot{S}i+3\ddot{A}l^2\ddot{S}i+3\dot{H}.$$

4 atoms silica	=	2309·24	= pr. ct.	30·51
6 " alumina		3854·00		50·92
3 " lime		1068·06		14·11
3 " water		337·44		4·46
		7568·74		100·00

This result leaves but little doubt that the mineral here examined is the same as the Turkish Emerylite. That the American species will be found constant in containing water I have no doubt.

Great care was bestowed on the trials to detect zirconia, but none was found.

Corundellite.

The next mineral belonging to this series I have called *Corundellite*. This species in external characters much resembles the last, but its composition is different in important particulars. It is also found associated with the corundum and emery of Unionville, Chester Co., Pa. The specimen here analyzed is marked "D," and was taken by me in May last, from the mineral collection of the Chester Co. Cabinet, formed by Mr. Williams. It is in broad foliated masses of a yellowish white color, easily cleavable and apparently hexagonal in form, penetrated by hexagonal crystals of corundum. Inelastic, brittle, resembles common mica but not so strikingly as A. Hardness 3·5. Gravity 3. B. B. gives the same characters as the last species. No reaction could be obtained for lithia or boracic acid in any of the minerals of this series. The reaction for fluorine in this one was feeble. It is unaffected by strong acids even on long boiling, except partially by very strong sulphuric acid. Its qualitative analysis gave silica, alumina, lime, potash, soda and water, with a trace of iron and fluorine.

The following analysis was made by Mr. J. J. Crooke, on 1·389 gramme of the substance fused with carbonate of baryta. It yielded

			Oxygen.		
$\ddot{S}i$	·496 = per cent.	35·708	= 18·553	= 18·55	= 9
$\ddot{A}l$	·738	53·131	24·872	24·87	12
Ca	·101	7·271	2·042		
K	·017	1·224	0·207	2·36	1
Na	·006	0·413	0·110		
H and Fl	·032	2·303	2·050	2·05	1
	1·390	100·068			

This gives the ratios

$$\ddot{S}i^3\ \ddot{A}l^4\ \dot{R}+\dot{H}=\dot{R}\ \ddot{S}i+2\ddot{A}l^2\ \ddot{S}i+\dot{H}.$$

		Atoms.	Required.	Found.
3 atoms	silica	= 1731·94 = per ct.	36·31	35·708
4 "	alumina	= 2569·32	53·87	53·131
1 atom	lime	= 356·02	7·46	8·926
1 "	water	= 112·48	2·36	2·303
		4769·76	100·00	100·068

This species somewhat resembles margarite, and it may be shown on further examination that margarite is a hydrous mineral. At present it is reported as anhydrous, and its proportions of silica and alumina are different from the present species. Its analysis given by Hausmann on the authority of the Göttingen Laboratory is

Silica,	33·50 =	8 atoms.	Silica,	= 4618·48	per ct.	34·47
Alumina,	58·	12 "	Alumina,	7708·00	"	57·55
Lime,	7·50	3 "	Lime,	1068·06	"	7·98
Protox. iron,	·42					
Manganese,	0·03			13394·54		100·00
Magnesia,	0·05					
	99·50					

$$\dot{R}^3\ \ddot{A}l^{12}\ \ddot{S}i^3=\dot{R}^3\ \ddot{S}i^2+6\ddot{A}l^2\ \ddot{S}i.$$

Possibly a new analysis may bring these species together.

The species Corundellite occurs not only in the broad foliated masses above alluded to, but also in small scales disseminated throughout the mass of granular corundum, at Unionville, Pa., and in this form is quite abundant. Not unfrequently these scales have a delicate shade of violet, especially when wet. The rock is difficult to break and the corundellite appears to adhere very strongly to the associated minerals, and the laminæ are not so easily separable as in the foliated masses.*

Euphyllite.

This beautiful pearly white mineral is found associated with black tourmaline and corundum, at Unionville, Pa. Form apparently hexagonal, cleavage eminent on basal plane, the laminæ

* The species *Barsowite* (G. Rose), appears in the Urals to hold the same geognostic relations to corundum as do the minerals of the present memoir, in this country. Its composition, however, is quite distinct, (silica 49·01, alumina 33·85, lime 5·46, magnesia 1·55=99·87, Varrentrapp,) while its hardness 6, and absence of micaceous structure render it entirely distinct. It approaches scapolite in composition, but with a smaller quantity of protoxyd. I am led to allude to this species from the fact, that an intelligent foreign mineralogist to whom I showed some of the corundellite, remarked that there appeared to be a similarity between the species. There is however a most marked difference in that corundellite is a mica.

not so easily separable as in mica. Hardness 3. G. 2·963. Lustre of sides faint pearly, of basal plane very brilliant pearly, resembling Heulandite, but perhaps more brilliant even than in that species. *Color* of cleavage face pure white, of sides grayish, sea green or whitish. Laminæ rather brittle, inelastic, and quite transparent.

B. B. Exfoliates, fuses on edges of thin laminæ and emits a stronger light than either of the corresponding species. In the matrass, it evolves water and gives a reaction for fluorine. No reaction for lithia or boracic acid was obtained, but it gives a soda yellow to the flame.

The qualitative analysis of this mineral gave silica, alumina, lime, magnesia, soda, water, and fluorine.

The quantitative analysis was conducted by Mr. J. J. Crooke, and gave on fusion with carbonate of baryta the following results, viz., quantity taken, 1·378 gramme, found—

					Oxygen.	
$\dddot{Si}$	·538	= per ct.	39·042	=	20·28	= 15
$\ddot{Al}$	·708	"	51·378		23·99	18
Ca	·044	"	3·193	0·897		
Mg	·015	"	1·088	·421	1·54	1
Na	·012	"	0·871	·223		
$\dot{H}$	·063	"	4·593		4·08	3
	1·380		100·165			

This gives the following as the theoretical composition of the mineral.

5 atoms	silica	= 2886·55	= per ct.	39·02
6 "	alumina	= 3854·00	"	52·10
1	Ca Mg	= 319·38	"	4·32
3 "	water	= 337·44	"	4·56
		7397·37		100·00

The following formulas therefore express its constitution.

$$\dddot{Si}^3\ \ddot{Al}^6\ \dot{R} + \dot{H}^3 = \dot{R}\ \dddot{Si} + 2\ddot{Al}^3\ \dddot{Si}^2 + 3\dot{H}.$$

The alumina obtained in this analysis (as well as in all the others also) was very critically examined for zirconia, but without success.

The black tourmaline which is associated with euphyllite has left the impression of its crystals on the lateral face of the mineral with such a smooth hard looking surface that it shows no trace of a micaceous structure. The tourmaline has an uncommon form, the faces R of the primary form being rudimentary from the extension of the tangential plane, truncating the summit.

The beautiful foliæ of this pearly white mineral have suggested the name *Euphyllite*, as an appropriate designation for the species, while the name *Corundellite* has the same obvious derivation as *Emerylite*, the mineral described by Dr. Smith.

There is a similar mineral associated with the blue corundum of North Carolina, which was made known to mineralogists by Hon. T. L. Clingman, M. C., from North Carolina. It occurs investing the corundum. Color faint olive brown. Lustre vitreous to pearly, like mica. In cleavable plates apparently hexagonal. Cleavage perfect, laminæ separable. H. 3. G. 2·94 to 3·008. Brittle, transparent, not acted on by strong acids. B. B. whitens, gives a brilliant light, but does not fuse, unless with great difficulty on the edges. It contains a trace of fluorine, and a qualitative analysis detected in it silica, alumina, lime, soda and water. An insufficient quantity of the mineral prevented a perfect analysis being made. So far as its constituents have been obtained, it contains silica 36·369, alumina 42·373, lime 10·141, magnesia 4·462, water 1·448, the difference soda and loss. Soda about 4 per cent.

Should it appear on repeating the analysis of this mineral, that it is new as the present would appear to indicate, I would propose to adopt the name *Clingmanite*, suggested by Prof. Shepard, in honor of the distinguished gentleman before named, who has shown great interest in advancing the study of mineralogy.*

The following tabular arrangement will make the constitution of these species of easy comparison.

		$\dddot{S}i$	$\dddot{A}l$	$\dot{C}a$	$\dot{M}g$	$\dot{N}a$	$\dot{K}$	$\dot{H}$ & Fl.	$\dddot{Z}r$	Total.
1. Emerylite of Smith, ..		30·	50·	13·	....	....	3·	....	4	100·00
2. " Pennsylvania,		33·50	58·	7·50	0·005[a]	....	....	....	..	99·50
3. Margarite, ...		31·260	51·199	9·239	0·283	2·969	....	5·276	..	100·
4. Corundellite, ...		35·708	53·131	7·271	....	0·413	1·224	2·303	..	100·068
5. Euphyllite, ...		39·042	51·378	3·193	1·088	0·871	....	4·593	..	100·165
6. Clingmanite ?		36·369	42·373	10·141	4·462	....	....	1·448	..	94·783
				$\dot{R}$						
The formulas given yielded on calculation,	1....	31·91	53·30	14·79	....	....	....	....	..	100
	2....	30·51	50·92	14·11	....	....	....	4·46	..	100
	3....	36·31	53·87	7·46	....	....	....	2·36	..	100
	4....	39·02	52·10	4·32	....	....	....	4·56	..	100
	5....	34·47	57·55	7·98	....	....	....	....	..	100

[a] +Fe 0·42 and Mn 0·03

* Prof. C. U. Shepard had noticed this mineral, and supposing it to be new, he had determined to give it the above name. When he found, however, that I was engaged on this series of minerals, he promptly abandoned the investigation. At that time we both thought that the Emerylite of Dr. Smith would probably include all the American species herein described, which now appears not to be the fact. On going to England in June, Prof. S. left me a memorandum containing his notes on the North Carolina mineral, and I have embodied them in the above description with my own.

I have had no means of comparing the optical properties of these several minerals. The angle between their axes of polarization should be measured to ascertain if the differences shown in their composition are found also in their molecular structure. When we review the characters of the minerals here described, we are struck with the almost identity of all their ordinary physical characters, and yet there are differences which are apparent especially in their composition. It therefore becomes an interesting question to decide if the optical characters will sustain the chemical results. The occurrence of a class of salts with such a very small amount of protoxyd bases, and so large a content of alumina as these possess, is a novelty in the chemical history of minerals, and may have some important theoretical connections. Our knowledge of the whole mica family is quite imperfect at present. The true function of the fluorine found in so many of them yet remains to be explained, and especially is it of the greatest importance that a careful series of optical measurements should be made on authentic specimens from numerous localities, and at the same time an exact series of chemical analyses conducted on specimens from the same localities.

Mineralogy hardly offers a more inviting investigation than this, and should it not fall into better hands, it will at a future day be attempted in this Laboratory.

II. On Unionite.

The next mineral to be noticed is from the same specimen which furnished me the *Euphyllite*. In general appearance it somewhat resembles scapolite or spodumene. It is implanted in black tourmaline, and is intimately associated with the euphyllite. Its form is discernible only by its cleavages which are distinct in one direction, the planes dividing the mineral into parallel laminæ, in two other directions less distinct, but yielding a form probably triclinate.* Lustre vitreous. Color yellowish white to white. Hardness 6–6·5. Gravity 3·2984. Brittle, and easily reduced to powder. In acids does not gelatinize.

B. B. In forceps it whitens, swells up and fuses to a white enamel, giving out at the same time an extremely brilliant light. In the matrass it gives out water which is acid, and the glass is etched with fluo-hydric acid. Qualitative analysis detected silica, alumina, magnesia and soda. The amount of water was determined by the loss on heating, and the fluorine was not separately estimated. In the quantitative analysis the mineral was attacked by carbonate of baryta.

The following are the results of analysis.

* The angles do not admit of measurement.

Taken ·7335 grammes. Yielded—

					Oxygen.	
$\dot{\dot{S}}i$	·32385 =	per ct.	44·151 =		22·940 =	7
$\ddot{A}l$	·31000	"	42·263		19·763	6
Mg	·05400	"	7·361	2·85	3·290	1
Na	·01270	"	1·731	0·46		
H and Fl	·02590	"	3·532		3·146	1
Loss	·00705	"	0·962			
	·73350		100·000			

7 atoms silica	= 4041·17	= per ct.	44·86
6 " alumina	= 3854·00	"	42·78
3 " magnesia	= 775·06	"	8·62
3 " water	= 337·44	"	3·74
	9007·67		100·00

$$\dot{R}^3\,\ddot{A}l^6\,\dot{\dot{S}}i^7\,\dot{H}^3 = \dot{R}^3\,\dot{\dot{S}}i + 6\ddot{A}l\,\dot{\dot{S}}i + 3\dot{H}.$$

This formula and constitution are believed to be unknown in any previously noticed species among minerals, and I therefore propose it as new and suggest for it the name *Unionite*, derived from Unionville, its locality. At present it is a rare substance, but I understand that the place where it was found is to be worked soon for emery, and probably both it and the Euphyllite will be obtained there in abundance. This species was also supplied to me by Mr. Williams of West Chester.

III. On Monrolite.

A mineral resembling Wörthite.—My attention was called to this mineral by Mr. Wm. S. Vaux, of Philadelphia, who had received it from the locality marked "topaz." It somewhat resembles pycnite in general aspect, but as will be seen is a very different thing.

It occurs at Monroe, Orange Co., New York, where it is found in a quartzose rock with magnetic iron, pink feldspar, black mica, pinite and common garnet. Color green to greenish gray. Structure radiating in sheafs from a centre in groups from an inch to two inches in diameter. Also in single implanted individuals. Cleavage and form of single crystals resembles sillimanite. Hardness 7·25 on an angle; on cleavage face about 6. Gravity 3·045, 3·096, 3·07. Columnar, fibrous. The oblique prisms were not measured, being too irregular.

B. B. Alone in tube gives off neutral water. Infusible, whitens; dissolves slowly in carb. soda, readily in borax and in salt of phosphorus, leaves a siliceous skeleton which reacts slightly for iron.

Its qualitative assay indicated the presence of silica and alumina, with a trace of iron and magnesia.

It was fused with carb. potash and caustic potash, and its analysis yielded

	I.	II.	III.
Silica, . . .	40·92	40·389	40·389
Alumina, . .	56·61	55·729	56·618
Magnesia, . .	·28	·280	·280
Water, . .	3·09	1·840	2·794
	100·90	98·238	100·079

These analyses correspond closely with $8\ddot{S}i\ 10\ddot{A}l\ 3\dot{H}$.

8 atoms silica		= 4618·48	= per ct.		40·59
10	" alumina	= 6423·30	"		56·44
3	" water	= 337·44	"		2·97
		11379·22			100·00

We have then the formula

$$8\ddot{A}l\ddot{S}i + \ddot{A}l^2\dot{H}^3.$$

The Wörthite of Hess gave the formula

$5\ddot{A}l\ddot{S}i + \ddot{A}l\dot{H}^3$ corresponding to his analysis, viz.:

Silica, ...	40·79
$\ddot{A}l$	53·06
$\dot{H}$	4·63
$\dot{M}g$	0·88
	99·36

I have never seen the Wörthite and have therefore no means of judging of the similarity of these two minerals in other respects. The probability of being able to refer the present mineral to kyanite seemed to me at first quite strong, but I was unable by any care to procure an amount of silica less than that given in these analyses. Should this mineral on further examination and comparison prove to be distinct, I propose for it the name Monrolite, derived from the locality where it was found.

IV. On the identity of Sillimanite, Fibrolite and Bucholzite with Kyanite.

Sillimanite was originally described by Bowen,* from an analysis made in Yale College Laboratory in 1825; which showed it to be a silicate of alumina with a proportion of silica too high to allow it to come within the formula of kyanite. It was subse-

* Jour. Acad. Nat. Sci., Phil., iii, p. 375.

quently analyzed by Dr. Thomas Muir, in the Laboratory of Dr. Thomson, who found in it a large quantity of zirconia, an observation which all subsequent researches have failed to confirm. Since that time it has been analyzed by various chemists, viz.: by Connel, Norton, Staff, Hayes and Thomson. The most recent of these analyses which has been published is that by Thomson, who reports it to contain 45·65 per cent. of silica. We have then the following discordant results in the amount of silica found in Sillimanite by different chemists in the order of their publication:

	1. Bowen.	2. Muir.	3. Connel.	4. Norton.	5. Staff.	6. Hayes.	7. Thomson.
Per cent.	42·67	38·67	36·75	37·40	37·36	42·60	46 65

The cause of this disagreement will undoubtedly be found in the difficulty of effecting a complete decomposition of anhydrous silicates of alumina, which contain a high per centage of alumina. This decomposition can be completely effected only by the aid of caustic potash applied to the mixture of carbonates and the mineral during the fusion, as first recommended by Berzelius, or by fluo-hydric acid.

Select crystals of this mineral were taken from the original locality at Chester, Conn., and their analysis afforded the following results: Quantity taken, 775·5 grammes, found,

Silica, ...	·292	= per ct.	37·653
Alumina, ...	·484	"	62·411
	·776		100·064

			Required.
2 atoms silica	1154·62	= $\dddot{S}i$	37·47
3 " alumina	1927·00	$\dddot{A}l$	62·53
	3081·62		100·00

This result gives then exactly the formula of kyanite, viz.: $\dddot{A}l^2\,\dddot{S}i^3$. The analyses of Staff and Norton give also the same result.*

We can therefore have no longer any hesitation in referring sillimanite to kyanite, as originally suggested by Haidinger.†

Bucholzite is a name given by Brandes to a silicate of alumina from Tyrol, which occurs in compact masses of a finely fibrous

* In Prof. Norton's analysis, which was made in Yale College Laboratory, the excess of 2·73 was owing undoubtedly to aluminate of potash which remained with the alumina after separating the peroxyd of iron by caustic potash. Subtracting this sum from the sum of alumina and peroxyd of iron, we have 62·30 per cent. alumina and peroxyd iron, which is almost exactly the quantity required by theory, and I have corrected the analysis accordingly with the consent of Prof. Norton. That analysis was made on the sillimanite from Fairfield, New York.

† In his translation of Mohs, vol. iii, 154.

structure and hardness equal to kyanite. Thomson also has analyzed a mineral from Chester Co., in Pennsylvania, well known to collectors, and has referred it to Bucholzite.* Being in possession of authentic specimens of the Chester mineral, I have analyzed it with the following result. Quantity taken 0·561 gramme. Found,

				Another sample.
$\dddot{S}i$ . .	·1925 =	per ct.	34·31	35·96
$\ddot{A}l$ . .	·3615	"	64·43	
$\dot{M}g$ . .	·0028	"	·52	
$\dot{M}n$ . .	trace	"	trace	
	·5568		99·26	

This also will give us the same formula with kyanite. The mineral being less pure than sillimanite, cannot be expected to furnish results as accurate as the former analysis. Prof. Shepard in his "System" expresses the opinion that bucholzite and sillimanite were the same species.

There is also found at Brandywine Springs, Delaware, a mineral which has been extensively circulated under the name of both bucholzite and fibrolite. A specimen from this locality furnished me the following results, viz.: Quantity taken 1·0675 gramme. Found—

Silica, ...	·386 =	per ct.	36·159
Alumina, . . .	·679	"	63·525
	1·065		99·684

This is evidently identical with kyanite. Minute traces of iron and manganese, which are found in both the above, are regarded as of no importance in the result, being mere impurities.†

Fibrolite of Bournon. This mineral was first distinguished by Count Bournon, who detected it among the associated minerals of corundum from India and from China. The name has reference to its fibrous character. It was analyzed by Chevenix, who found

* Erdmann appears also to have made his analysis on the mineral from the same locality.

† It may be objected to the conclusion that bucholzite is identical with kyanite that I have not analyzed a specimen of the original mineral. This I should have done could I have procured one in season for my present purpose. The Chester mineral here analyzed was received by Baron Lederer from Dr. Nuttall, and so far as I can learn, no one questions that the mineral from that locality corresponds entirely with the bucholzite of Brandes. I am convinced that those chemists who have obtained so high a percentage of silica in their analyses of *disthene* minerals, have not taken the precaution to employ the aid of caustic potassa, *added to the assay during fusion*, as recommended by Berzelius; and that if they had re-analyzed their silica they would invariably in cases where the amount exceeded 38 per cent., have found in it a portion of alumina.

Silica, ...	38·
Alumina, ...	58·25
	96·25

Even upon so imperfect an analysis, there has been no hesitation with most writers in referring it to kyanite. Having a specimen of this mineral from Count Bournon at my disposal, I have analyzed it.* It yielded on 0·427 gramme taken:—

Silica, . . .	·1551	= per ct.	36·309
Alumina, . .	·2665	"	62·415
Magnesia . .	·0030	"	·702
	·4246		99·426

The results just given leave it no longer possible for us to separate sillimanite, bucholzite and fibrolite from kyanite. The hardness of sillimanite proves also to possess the same inequality on different faces which is found in kyanite. The cleavage face is much softer than the angle or side of the prism, so as to be easily scratched with a sharp point of hard steel. The crystalline forms of sillimanite and kyanite are also identical, the one being derived by the simplest modification from the other. The cleavage in both is in the orthodiagonal.

It may be worthy of remark that "Andalusite" has the same chemical constitution as kyanite, but belongs to the right rhombic form, while kyanite is oblique. Doubtless a case of dimorphism, and perhaps the same may be said with truth of staurotide.

My pupil, Mr. George J. Brush, afforded me essential aid in the foregoing investigation.

V. On a Granular Albite associated with Corundum, and on the Indianite of Bournon.

A specimen of a granular mineral was sent me by Mr. G. of Andover, last year, with the remark that it was found in beds in Lancaster Co., Penn., and was so hard as to resist all attempts to penetrate it by hardened steel—greatly impeding the operations of the miners in the chrome iron districts.

I also received other specimens of the same from Mr. Williams of Westchester, associated with corundum which was found imbeded in it, and from this circumstance it has been mistaken by some mineralogists for *Indianite*, which species it resembles in hardness, gravity and in granular structure, but not at all in composition.

* The specimen referred to was taken from the collection of Col. Gibbs, (now in Yale College,) and was received by him from Count Bournon in a large collection of gems which this gentleman furnished to Col. G.

In its granular structure it so resembles dolomite that no difference can be detected between them by the eye, while its hardness, and great difficulty of fracture completely blind the enquirer as to its real character. Its characters are as follows:—

Massive, compact, granular, resembling white dolomite; tough; fracture even but very difficult. Color white with shades of gray. Streak white. Hardness 7–7·25 (scratching quartz with facility). Gravity 2·619.

Insoluble in acids. B. B. infusible and does not *color the flame yellow;* with the fluxes yields evidence of $\dddot{Si}$, $\ddot{\mathbf{A}}l$ and Ca. By a quantitative fusion with carbonate of baryta soda was detected.

The first specimen analyzed was from Lancaster Co., Penn., and showed no trace of corundum disseminated in it.

This analysis was made by Mr. G. J. Brush and yielded on the quantity taken 1·234 gramme as follows:—

			Oxygen.	
Silica,	·8225 = per ct.	66·653	= 34·85	= 12
Alumina,	·2565 = "	20·786	10·70	3
Lime,	·0253 = "	2·050		
Magnesia,	·0071 = "	0·519	3·08	1
Soda,	·1155 = "	9·360		
	1·2269	99·420		

It gives the constitution $\dddot{Si}^4\ \ddot{\mathbf{A}}l\ \dot{Na} = \ddot{\mathbf{A}}l\ \dddot{Si}^3 + \dot{Na}\ \dddot{Si}$.

4 atoms silica	= 2309·24	= per ct.	69·09
1 " alumina	= 642·33	"	19·22
1 " soda	= 390·90	"	11·69
	3242·47		100·00

This is precisely the formula and constitution of an albite.

The second analysis was on a specimen from Unionville, Chester Co, Pa., having identical characters, but associated with corundum which occurs implanted in it. This analysis was made by Mr. M. C. Weld. Quantity taken 2·180 gramme. Found—

			Oxygen.	
Silica,	1·4575 = per ct.	66·857	= 12
Alumina,	·4772 "	21·889	3
Lime,	·0389 "	1·785		
Magnesia,	·0105 "	·481	1
Soda,	·1914 "	8·779		
Water,	·0105 "	·481		
	2·1860	100·272		

This obviously yields the same formula as the last analysis.

The extreme hardness of this mineral is its most remarkable quality and is not easily accounted for. It is probably connected

with its association with corundum, for we find the quality equally developed in the Indianite, (or anorthite,) the Asiatic associate of the same species.*

Analysis of Indianite.—I thought it of interest in connection with the foregoing analyses to make a new analysis of Bournon's *Indianite*, which, as already remarked, is found to be the matrix of the corundum in India. Being possessed of an authentic specimen, I requested Mr. Brush to conduct the analysis, the results of which are now given. This mineral is granular and of a pink color, sometimes gray or blackish, very tough and hard. Hardness 7–7·25. Gravity 2·668. It gelatinized completely in cold chlorohydric acid. Before the blowpipe alone infusible. The analysis gave on 1·594 gramme,

					Oxygen.	
Silica,	·6710	= per ct.	42·09	=	21·869	= 4
Alumina and a trace of iron,	·6200	"	38·89		17·160	3
Lime,	·2516	"	15·78	4·449	5·592	1
Soda,	·0651	"	4·08	1·043		
	1·6077		100·84			

$$\dddot{Si}^4\,\ddot{R}^3\,\dot{R}^3 = \dot{R}^3\,\dddot{Si} + 3\ddot{R}\,\dddot{Si}$$

which is the formula for anorthite.

VI. On the Boltonite of Shepard, and Thomson's Bisilicate of Magnesia.

The Mineral named Boltonite by Prof. Shepard† is found at Bolton in Mass., in a lime quarry, disseminated in irregular masses, seldom showing any traces of crystalline form. The description of Prof. S. is quoted below.‡

The changes of color are peculiar, and often the same mass which is dark greenish gray on one end, will have turned light yellow on the other.§ Hardness 5·50; specific gravity 3·008—the same on two specimens, one dark and one light.

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* Dr. Martin H. Boyé of Philadelphia, has lately informed me in conversation, that he also made an analysis of this granular albite some time since, and with results closely accordant to those here given. See Proceed. Am. Phil. Soc.

† Shepard's Treatise on Mineralogy, New Haven, 1835, vol. i, p. 78.

‡ Prof. Shepard's description is as follows—"Massive, composition granular: individuals large, cleavage in one direction pretty distinct, in two others oblique to the first, indistinct, but affording indications of a doubly oblique prism, fracture uneven or small conchoidal. Lustre vitreous. Color blueish gray, yellowish gray, wax yellow to yellowish white. The darker colors change to yellow on exposure to the weather. Hardness 5·0–6·0. Gravity 2·8–2·9."

§ Mr. Saemann of Berlin, Prussia, in a paper read before the Am. Assoc. for the Promotion of Science at Cambridge, attributes the change of color in Boltonite to minute grains of magnetic iron found disseminated in the substance of the crystals, which, undergoing change by exposure, leave the mineral of a lighter color than it was when fresh.

This mineral when first found, was called *Pyrallolite*, and is now so labelled in some old collections. Baron Lederer's Cabinet of American Minerals, now in the Yale College collections, contains eight or ten specimens of this mineral from Bolton, under the name Pyrallolite, which were received, as the catalogue indicates, from Robinson, Shepard, Nuttall, Boyd, and other of the early cultivators of American mineralogy.

In his remarks on this mineral, Prof. Shepard says, it is believed to be identical with the substance described by Dr. Thomson* under the name of "bisilicate of magnesia;" and accordingly the analysis of Dr. Thomson is quoted under "Boltonite," as giving the supposed chemical constitution of this substance.

It will presently be shown that there is every probability that Dr. Thomson applied the name bisilicate of magnesia to another substance. and that the Boltonite of Prof. Shepard is not the substance which he analyzed.

Having received specimens of Boltonite from Mr. Saemann, a very intelligent and discriminating mineralogist from Berlin, I was induced to undertake an analysis of it which gave me the following results. The specimen analyzed was the yellow variety. ·5753 gramme of substance gave:

				Oxygen.	
Silica,	46·062 =			23·93 =	8
Alumina,	5·667			2·64	1
Magnesia,	38·149	14·76			
Protox. Iron,	8·632	1·95	=	17·14	6
Lime,	1·516	·43			
	100·026				

Formula $\dddot{S}i\ 1\ddot{A}l\ 18\dot{M}g = \dot{R}^3(\dddot{S}i, \ddot{A}l)$ or $(\dot{M}g, \dot{C}a, \dot{F}e)^3(\dddot{S}i, \ddot{A}l)$

8 atoms silica	= 370·08	= pr. ct.	46·556
1 atom alumina	= 51·47	"	6·372
18 atoms magnesia	= 372·66	"	47·072
	794·91		100·000

If we consider the alumina as not an essential constituent of the mineral instead of replacing a part of the silica, (a view, which I am not disposed to take,) then we shall have a silicate of magnesia and the other bases, whose formula will be

$$\dot{R}^9\ \dddot{S}i^4.$$

Referring to Thomson's analysis and description of his bisilicate of magnesia, we read (loc. cit. p. 50) that the mineral received by him from Mr. Nuttall, (from Bolton, Mass.,) bears so much

* Am. Lyc. Nat. Hist., New York, vol. iii, p. 50.

resemblance to the picrosmine of Haidinger, both in character and composition, "that he strongly suspects the two things to be mere varieties. The mineral is white, with a shade of green, powder white. *It consists of a congeries of prismatic crystals, very irregularly disposed, and involved in each other. Lustre glassy;* transparent on the edges." The analysis gave:

Silica,	56·64
Magnesia,	36·52
Alumina,	6·07
Perox. iron,	2·46
	101·69

This analysis must certainly refer to another mineral than Boltonite. The description certainly does not compare at all with that of Boltonite, which cannot be said to "consist of a series of prismatic crystals," with a glassy lustre and faint green color. Nor is it white. In searching among the minerals from Bolton, in the cabinet of Baron Lederer, for something corresponding with Thomson's description, I found one from that locality marked "Picrosmine?" "Actynolite?" This mineral answers the description of Thomson, quoted above, as nearly as anything could, and is undoubtedly the same thing which he received from Mr. Nuttall, and examined with the above results. Nothing else occurs at the locality at all resembling the mineral which is described by Dr. Thomson. A qualitative analysis of this specimen gave silica, magnesia, alumina, peroxyd of iron, manganese, but no lime or water. These are the constituents of a hornblende, and this specimen is undoubtedly such—variety actinolite.*

If the foregoing conclusions are correct, it would appear that Boltonite and "bisilicate of magnesia" are not the same mineral as described by Prof. Shepard.

The formula for Boltonite is that of a salt not before described, while that deducible from Thomson's analysis, corresponds as accurately as we could expect with common hornblende.

I am happy therefore to be able to reëstablish Boltonite as a species on good grounds.

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* I am altogether at a loss to understand what Dr. Thomson intends, when he says in his memoir before quoted, that the analysis here given corresponds to the constitution of a "Bisilicate of magnesia." For

2 atoms $\dot{\dot{S}}i$	=	92·52	= per ct.	81·72
1 atom Mg	=	20·70		18·28
		113·22		100·00

This result is entirely different from his analysis.

VII. On Nuttallite.

Nuttallite was established as a species by Mr. Brooke,* on general physical grounds, principally of hardness and color, and a slight departure from the usual angles of scapolite. It was analyzed by Thomson,† who found for it a constitution so different from scapolite, that it has been regarded as a distinct species by many mineralogists, and is so placed by Nicol in his Manual just published. I was induced to make a new analysis to decide the doubt regarding its true constitution. The mineral is partially decomposed by strong chlorohydric acid with heat, but it is not thus possible to obtain a complete analysis. The mineral is found at Bolton, Mass., in a white cleavable limestone with black augite. Having a good specimen, I requested Mr. Ludwig Stadtmuller, one of our pupils, to undertake the analysis. The following are the results confirmed by several trials. The alkaline constituents being determined by fusion with carbonate of baryta.

Silica,	45·791
Alumina,	30·107
Perox. iron,	1·861
Lime,	17·406
Potash,	3·486
Soda, Manganese,	traces.
Water,	1·630
	100·281

It is obvious from simple inspection, that this analysis corresponds exactly with scapolite, and we have no hesitation in referring nuttallite to scapolite.

Analytical Laboratory, Yale College, September 15, 1849.

Art. XXX.—*On the Prime Meridian;* by Lieut. Davis, U.S.N.

[Read before the American Association for the Promotion of Science, Aug. 15, 1849.]

The question is, whether, having a National Observatory, and being about to publish an American Nautical Almanac, we shall still continue to count our longitude from the meridian of Greenwich, or whether it is preferable for convenience, for accuracy, or for other reasons, to establish a new Prime Meridian on this continent.

I will endeavor to treat this question fully, and to present all the practical and scientific views in relation to it of which I am possessed.

* Ann. of Philos., xli, p. 366. † N. York Lyceum Nat. Hist., vol. iii, p. 82.

It would undoubtedly be for the advantage and convenience of all civilized nations if a general meridian were adopted by common consent; if all longitudes were counted in the same manner and from a single origin. The man of business, the general student, and, above all, the navigator, would profit by this rule; and the man of science would also find it beneficial in removing the necessity for those allowances and calculations occasioned by the variety of meridians, and with them, a constant source of error.

The Congress of the United States, in a report of one of their committees upon a proposition to make the capitol the first meridian, evinced at an early period an enlightened apprehension of the benefits that would result from the establishment of a general meridian.*

But it also was fully aware how little probable such an event was then, and there are obstacles in the way of its occurrence now, which render it distant and doubtful. It is not to be denied that our own situation is, in some respects, unfavorable for originating successfully such a project. If, nevertheless, you should agree with me, in thinking that the opinions which have been entertained for a long time by scientific and practical men here and elsewhere, should be again consulted, I shall be most happy, under your instructions, to communicate on this subject with European astronomers.

In the mean time we are called to decide upon a meridian for present use. This decision is the basis in my work. Hitherto we have used the English meridian of Greenwich; all our geographical positions and territorial limits are fixed according to it, our astronomical calculations are based upon it, our nautical charts and books of navigation are adapted to it, and our chronometers are set to its time. It has been so much our general practice to count from this meridian that it constitutes a part of our familiar thought and knowledge.

On this account, and especially with reference to the convenience of our wide spread and growing commerce, a change of the old meridian, if necessary, should be reconciled, as far as practicable, to the wants and habits of the country.

The scientific importance of assuming, at present, an American meridian is undoubted. So long as we depend upon that from which we are separated by an ocean, our absolute longitudes remain indeterminate. Such are the difficulties attending the astronomical determination of this element, that the greatest accuracy attainable is only an approximation to the truth; varying, as observations or computations are multiplied, or as new and better methods and values are introduced. There is no place on our coast, the longitude of which from Greenwich is so well ascertained as Boston. The observations and computations made for

* Report of the committee on Lambert's memorial, Jan 25, 1810.

this purpose by the late Dr. Bowditch, and communicated to the American Academy, bear the marks of his genius and labor. The means of determination have since been greatly multiplied —solar eclipses, occultations, and moon culminations, have been collected in great numbers. The transportation of numerous chronometers between England and Boston has afforded the materials of further improvement. Commodore (now Admiral) Owen, whilst engaged in the survey of the Bay of Fundy, carried his chronometers to Boston, adopting that as his American first meridian, because it was the best determined. Mr. Bond, the Director of the Observatory at Cambridge, has been for several years, employed in the service of the government, in accumulating all the means of perfecting the longitude of Boston. Yet I am informed, that there still exists an uncertainty in this longitude, notwithstanding all the labor and care bestowed upon it, to the amount of, perhaps, two seconds of time. It is, also, a pregnant fact, worth mentioning, that the relative longitudes, even of the Greenwich and Paris observatories, have been recently changed.

But the uncertainties arising from the intrinsic difficulty of making absolute determinations of longitude increase as the place is more remote, and therefore less known or cared for. The assumption of a new origin of longitude situated in this country, will, to a considerable extent, remove these uncertainties, and save us from those fluctuations in our geographical positions to which we are now subject. In the magnetic telegraph we have a means of determining differences of meridians, which belongs to the highest order of accuracy. It can be applied at once wherever the wires now run. An American prime meridian being adopted, this should be done as soon as possible. As the use of the telegraph is extended, the interior, throughout its whole space, would be connected in this manner with the stations of the coast survey and the national observatory, and would have the geographical positions of its chief cities and county towns permanently and unalterably fixed, and thus the foundation would be laid of a correct geographical map of the whole country.

In making a change, however, that is so radical with regard to some of our citizens and their pursuits, great consideration is to be had, I think, for their practical wants and conveniences. These last should be no farther sacrificed than the first demand of an independent accuracy strictly requires. Our navigators and seafaring people generally, are chiefly concerned in the result of this change. Speaking a common language with the greatest commercial nation of the world, our own vessels are constantly meeting those of Great Britain on the highway of nations, and are in the habit of comparing with them their longitudes. From this facility and frequency of intercourse they receive and confer

great benefit, upon which sometimes the safety of a vessel at sea may depend. They are also accustomed to employ British charts and chronometers; and it is very desirable to secure the greatest possible facility for their use, and comparison for the future, and in every quarter of the world; throughout all parts of which our communication with British ships, ports, and means of navigation is intimate and habitual.

For these and similar reasons, it will be better if our own meridian is so situated as to admit of an easy interchange with that of Great Britain, particularly at sea, where intercourse is always necessarily brief, and frequently, owing to circumstances of weather, distance, or haste, very difficult.

If the meridian of Washington, which, as the capital of the country, it will first occur to us to select, be adopted, it will prove unsuited to these emergencies. The longitude of Washington is in time about 5h. 8m. and 16s., or in space 77° 04′ from Greenwich. These are inconvenient sums to add or subtract; their application is not ready and easy. This meridian will also cause that kind of difference in the division of our charts, the face of our chronometers, the reading of our text-books of navigation, &c., which would seriously interfere with the habits of our present, and the wants of our future nautical men. These as I have said, are considerations worthy of great regard.

The life of commerce subsists by the mutual interchange of relations, not material only, but also personal and intellectual. These relations are, in our case, much more numerous and complex with Great Britain than with any other nation, on account of her large fleets, her distant colonies, and our community of speech. We may omit to provide for the wants and habits growing out of them, but we cannot alter, indeed as a great commercial people we do not desire to alter, the fact of their existence.

To avoid in some measure the difficulties and inconveniences already stated, and to satisfy as far as possible, the demands of daily practice, I propose to establish an arbitrary meridian at the city of New Orleans, which will be exactly six hours in time and ninety degrees in space from the meridian of Greenwich. These round numbers are easy in their use and application. They are taken from or added to the headings of charts, the readings of chronometers, or the values in the astronomical ephemeris, without delay, and with little danger of mistake.

They are also convenient for the interchange of longitudes at sea. This meridian cuts the great valley of the west, and approaches to the central line of our territory on this side of the Rocky Mountains. It passes nearly through the centre of the great eastern slope of the continent, and enters the city of New Orleans, the mart and outlet of its products and trade. I propose to call it the meridian of New Orleans, in which city a spot is to

be found having this suitable difference of meridian of six hours, or one quarter of the circumference, from our present standard meridian of Greenwich.

This choice has other recommendations, which give it the preference over Washington. The meridian of the latter cuts the coast between Cape Fear and Cape Lookout. Our coasting vessels, and domestic packets, therefore, in going and returning between our northern and southern ports would be subject, if it were taken, to the inconvenience of a change of name in the longitude, which, as is well known to navigators, always involves a liability to error.

The meridian of New Orleans on the other hand, is so far west, that all the longitudes on the Atlantic coast remain on the same side. It is only on the coast of Louisiana, west of New Orleans and of Texas, that they change. This change takes place where the river Mississippi empties its turbid waters into the Gulf, where nature has marked the line by an altered condition of the water, such as may be observed by the careful seaman at some distance from the land.

Another practical recommendation of this choice is this: If New Orleans be adopted, then between the American and English meridians, the degrees and minutes on the chart will be the complements of each other. To the westward of the American meridian, up to 180°, the minutes will be the same, the degrees being less by 90°. To the eastward of the English meridian there is the same advantage; the number of degrees on our part being greater by ninety, up to 180° of the English longitude. Between the inferior meridians of the two nations for the space of 90°, the sum of the American and English longitudes will be equal to 270°, but they will be of different names.

These normal differences are easily remembered, and compare favorably with the confusion that will follow, if the modes of reckoning longitudes by the two nations differed by so unmanageable a quantity as 77° 04′. The time is not distant when we shall have published, under the authority of the government, perfect charts of our harbors and external sea-coast. I trust also that the day is not far distant when foreign charts (improved by surveys made by our own officers) will be issued from the bureau of Hydrography of the Navy Department, for the benefit of the commercial marine of our own and other nations. These charts should be rendered as serviceable and available as possible to the whole maritime world; and this end will be attained in the manner pointed out above. What is for our own advantage will prove beneficial to others.

It may be proper to observe here, that although I speak only of the meridian of New Orleans as arbitrary, yet all prime meridians are essentially arbitrary. They have been selected always with a sole reference to the national convenience. Some nations, as

the French, Portuguese, and Dutch, have placed their prime meridians out of their own country; but I need not consume space by entering into historical details that are easily obtained.* The early conduct of the French, however, in this matter, deserves to be mentioned because it contains some instructions for ourselves. By a royal ordinance of Louis XIII, the island of Ferro was established as the French first meridian, and Paris was assumed to be twenty degrees to the eastward of it. It appears from the memoirs of the Royal Academy of Sciences of 1742 and 1746, that attempts were subsequently made to fix with accuracy the exact distance of Paris from the island, notwithstanding that no precise spot on it had been designated as the origin of longitudes, and that there was a prevailing ignorance as to the topography and shape of the island. The determinations by different persons of course varied, and this caused those uncertainties and fluctuations in the French longitudes which led to the final abandonment of the assumed meridian. We may profit by this example.

Having decided to take for our prime meridian that great circle of the earth which is ninety degrees or six hours from Greenwich, we are to keep it wherever it may fall. By means of the magnetic telegraph, the distance of this circle from the meridian of the National Observatory can be determined with sufficient accuracy, and, being once determined, it is to be regarded as fixed and permanent. If it should be found necessary to make any change hereafter, that change will be applied to the imaginary meridian, and not to the meridional differences of other places from Washington, which are to remain always the same.

The Washington Observatory is thus made the virtual standard according to which all values are assigned, and to which all meridional differences are referred; and from which, also, all *absolute* longitudes are computed.

Its own distance from the six hour circle being once ascertained by magnetic communication, it will be, in effect, for this country, the true origin of longitude.

It will not be practically indispensable to distinguish by any visible, real mark, the meridian of New Orleans, so far as the National Observatory is concerned; for the latter, its distance in time from the arbitrary meridian being once assumed, becomes the effectual, established zero; but this mark will be useful for reference in the adjacent country, saving labor and time in fixing longitudes in its vicinity, and its foundation appears to be peculiarly proper as a national monument. The cost of such a mark will be but trifling.

Thus the new meridian will be, what its name implies, strictly arbitrary. It may be thought that there are reasons of a scien-

* See Encyc. Perthensis, and Britannica, art. Geog.—Good's Pantologia, and London Encyc., art. Meridian—Delambre's Hist. of Astronomy, Mackay on Long., &c.

tific character why the National Observatory at Washington should be selected as the nominal origin of longitude, on this continent. Such is not the case. Our National Observatory at Washington must have existed half a century before it will be able to furnish independent observations sufficient for the determination of a correct theory of the moon or primary planets. But these theories are already calculated from the observations (begun long since and uninterruptedly continued) at the old established observatories of Europe. In preparing new tables, I shall avail myself of the Washington observations to the utmost extent of their utility.

I propose, also, to give, in the Astronomical Ephemeris, the times of transit, and the corresponding places of the planets, and principal fixed stars, over the meridian of Washington.

Hitherto I have treated this question without an express reference to merely national views and feelings. So far as the subject is merely scientific, they do not enter; so far as it is practical, they are of paramount importance.

But I am very far from being seduced into a forgetfulness of national sentiments, by the silly pretense that there are or can be duties to science or to humanity, which are at variance with those to country; a notion, wherever it is held, that implies not only a want of patriotism, but of true humanity also. "Science knows no distinctions of country"—in its claims to support and in its exemption from hostilities—in its spirit and in its communions—in its highest aim, which is to study the laws of nature, and endeavor to make the knowledge of those laws useful to mankind.

But science, like all objects of human interest and pursuit, is compelled to recognize the distinctions of country in the duties it imposes, in the means of its progress, and in some measure in its associations and the limits of its operations. It prospers and is fostered by those affections which divide us into distinct families and nations, at the same time that they preserve our relation to the whole race.

Being designed to act within a limited sphere of usefulness, we are happily supplied with a motive to every duty in a corresponding affection, which, if rightly elevated and directed, renders the performance of that duty easy and agreeable.

Feeling assured that it is by laboring in the sphere assigned us that we are most likely to accomplish something that may be beneficial to mankind, and that by making ourselves good citizens of that state to which our efforts are unavoidably confined, we may best hope to prove ourselves useful citizens of the great republic of letters and science constituted by the union of all cultivated people, I indulge a sentiment of American pride and gratification, that another step has been taken by the government towards the promotion of science, by the foundation of an American Nautical Almanac.

NOTE.—The preceding paper is the substance of a letter addressed to the Hon. Wm. Ballard Preston, Secretary of the Navy, by Lieut. Davis, upon the latter being called to take charge of the preparation of the Nautical Almanac provided for by the act of Congress, approved March 3, 1849.

Lieut. Davis stated that he had been officially directed by Mr. Preston to lay this paper before the Association with the request that it should be submitted, for a report thereon, to a committee of members of the association, consisting of mathematicians and astronomers from various parts of the country. On motion of Prof. A. D. Bache, the paper was thus referred, and the following gentlemen were nominated by the President and confirmed by the Association as the committee.

Prof. A. D. BACHE, Supt. U. S. Coast Survey.
Lieut. M. F. MAURY, Supt. Nat. Observatory.
Prof. BARNARD, of Alabama.
Prof. LEWIS GIBBES, of S. Carolina.
Prof. COURTNAY, of University of Virginia.
Prof. S. ALEXANDER, of Princeton.
Prof. FRAZER, of University of Pa.
Prof. ANDERSON, of New York.
O. M. MITCHEL, of Cincinnati.
Prof. STANLEY, of Yale College.
WM. MITCHELL, of Nantucket.
Prof. LOVERING, of University at Cambridge.
Prof. SMYTH, Bowdoin College.
Prof. TRINLOCKE, of Kentucky.
Prof. COCKLEY, St. James, Md.
Prof. CURLEY, of Georgetown Coll.
Prof. FOWLER, of Tennessee.
Prof. PHILLIPS, of N. Carolina.
Prof. BARTLETT, of West Point.
Prof. SNELL, of Amherst.
Prof. CASWELL, of Providence.
Lieut. C. H. DAVIS, Supt. Naut. Alm.

ART. XXXI.—*Contributions to the Mycology of North America;* by the Rev. M. J. BERKELEY, of England, and the Rev. M. A. CURTIS, of South Carolina.

Mr. BERKELEY having generously proposed that the new species of Fungi which I communicate to him shall be published under our joint names, though the greater part of them would justly have fallen to his own share, they will henceforth be published accordingly. They will be first described in the London Journal of Botany by Mr. Berkeley, and transferred from thence to this Journal, with such alterations, additions or omissions, as later observation may demand, and as may best subserve the purpose of these contributions.—M. A. C.

31. AGARICUS (Amanita) AGGLUTINATUS, Berk. and Curt.—pileo ex hemispherico plano viscido e volva areolato, margine sulcato; stipite curto solido; lamellis latis liberis rotundatis. Ad terram in sylvis arenosis. Aug. Society Hill, S. C.

White, pileus 1–2 in. broad, scaly from the remains of the volva, margin thin. Stem $\frac{1}{2}$–$1\frac{1}{2}$ in. high, 2 lines thick, enlarged

at the apex, bulbous at base, furnished with a volva whose margin is free. Ring wanting. Gills broad, ventricose, rounded and free behind. Spores white, elliptic.—Resembling small forms of A. vaginatus, but distinguished by its solid stipe, more distant and thicker gills, and decidedly viscid areolato-squamose pileus.

32. A. ASPERATUS, Berk.!—In sylvis paludosis, Society Hill. This beautiful species was previously known only as an inhabitant of Ceylon.

33. A. FULIGINOSUS, Fries.—In umbrosis. June. Society Hill.

34. A. VELLEREUS, Fr.—In sylvis aridis. June, July. Society Hill. Item, Santee Canal. Mr. Ravenel.

35. A. ANGUSTISSIMUS, Lasch.—Ad terram. Aug. Santee Canal. Ravenel.

36. A. SCALPTURATUS, Fr.—Ad truncos pineos. Aug. Society Hill. Item, Santee Canal. Ravenel.

37. A. CONIGENUS, Pers.—Ad conos pineos dejectos in humidis. Wilmington, N. Car.

38. A. CLAVUS, Bull.—Inter muscos ad terram argillaceam. Sept. Hillsborough, N. C.

39. A. CIRRHATUS, Pers.—Ad terram subter asses. Aug. Society Hill.

40. A. CAMPANULATUS, Linn.—May. Society Hill. Item, Santee Canal, ad fimum vaccinum. June. Ravenel.

41. A. MURALIS, Sow.—In sylvis humidis. May. Society Hill.

42. A. SCYPHOIDES, Fr.—Ad terram in hortis. June, July. Society Hill.

43. A. PYXIDATUS, Bull.—Ad terram in graminosis. June. Santee Canal. Ravenel. Item, Hillsborough, N. C.?

44. A. BRUMALIS, Fr.—Ad truncos putridos. Sept. Santee Canal. Ravenel.

45. A. UMBELLIFERUS, Linn.—In sylvis humidis; Rhode Island. Mr. Olney.

46. A. ATROCŒRULEUS, Fr.—Ad Caryam dejectam. June, July. Society Hill.

47. A. POMETI, Fr.—Ad truncos dejectos. July. Hillsborough. N. Car. Has a pleasant anisate odor when fresh.

48. A. SEPTICUS, Fr.—Ad Polyporum corruptum. July. Hillsborough.

49. A. (PLUTEUS) CURTISII, Berk.!—pileo erugi viscido hepatico; stipite æquali solido glabro albo; lamellis liberis ex albo cinnamomeo-roseis. Ad lignum corruptum in paludosis. March–Oct. Society Hill.

Cap 2–3 in. broad, shining, from pale becoming livid or liver colored, smooth, margin thin. Flesh white, 2–3 lines thick in the centre. Lamellæ white (becoming discolored by the pale cinnamon colored spores), unequal, numerous but not crowded, ventricose, 3 lines wide, free and rounded at base, leaving a deep impression around the stipe. Stipe rather brittle, 2–3 in. long, about 3 lines thick, smooth and shining, somewhat thickened at base. Spores oval. Taste and smell disagreeable, but weak.

50. A. SINUATUS, Fr.—Rhode Island. Olney.

51. A. CAMPHORATUS, Fr.—Ad terram in umbrosis. June, July. Society Hill. Item, Santee Canal. Mr. Ravenel.

52. A. SANGUINEUS, Wulf.—In sylvis humidis inter folia. July–Sept. Society Hill.

53. A. PENETRANS, Fr.—Ad truncos dejectos corrumpentes. June. Society Hill. Item, Santee Canal. Ravenel.

54. A. LANUGINOSUS, Bull.—Ad humum lignosam in sylvis humidis. May. Society Hill.

55. A. SEMIORBICULARIS, Bull.—Ad terram fimosam. Aestate. Society Hill and Hillsborough.

56. A. VERVACTI, Fr.—Rhode Island. Mr. Olney.

57. A. FABACEUS, Berk. !—Ad terram pinguem. July–Nov. Santee Canal; Mr. Ravenel; and Society Hill. First discovered in Ohio by Mr. Lea. This is among the most delicious species for the table. The fresh specimen has a distinct taste and odor of peach kernels or bitter almonds, which are nearly lost in being cooked.

58. A. (Psalliota) ACHIMENES, Berk. and Curt.;—pileo plano glabro nitido verrucis exasperato; stipite floccoso-farcto; lamellis liberis ex albido cinereis.—Ad terram. June. Santee Canal. Mr. Ravenel. Item, Society Hill.

Solitary. Cap 4–6 in. broad, pallid or ochroleucous, smooth like kid leather, but studded with warty excrescences especially towards the centre. Stipe 4–6 in. high, 3–4 lines thick, white, stuffed with floccose fibres, furnished towards the apex with a large deflexed ring. Gills broad, crowded at first, whitish, then cinereous and fuscous, free. Spores brownish, oval or ovate.—A splendid species allied to the preceding, but differing in its paler spores, warty cap, ample ring, &c.

59. A. LACRYMABUNDUS, Bull.—Ad latera fossarum. Sept. Santee Canal. Mr. Ravenel.

60. A. VELUTINUS, Pers.—Ad terram humidam, &c. Apr., Sept. Santee Canal. Mr. Ravenel.

SCIENTIFIC INTELLIGENCE.

I. Chemistry and Physics.

1. *Deflection of the Magnetic Needle by the act of Volition,* (taken from Phil. Mag, xxxiv, 543.)—This curious and interesting experiment is due to the investigations of M. Du Bois Reymond of Berlin, and his method of performing it is as follows:—He takes a very sensitive galvanometer, and attaches to the terminal wires thereof two perfectly homogeneous strips of platina. These strips are dipped down into two vessels filled with salt and water, into which fluid, as contained in each vessel, two corresponding fingers of the two hands are to be plunged. On the first immersion of the fingers there is almost always observable a more or less decided deflection of the needle, this deflection not being amenable to any known law, and being in the opinion of the experimenter due to the difference existing to some extent and in some way or another between the cutaneous covering of the two fingers. Whenever there is a wound on one of the fingers the deflection is greater than usual; and its direction is uniformly such that the injured finger behaves like the zinc-side of an arc of zinc and copper, which we may conceive to be inserted between the two vessels instead of the human body. It need hardly be remarked, that it is not this sort of action to which in the experiment in question it is purposed to direct the attention. On the contrary, in order to observe the effects alluded to, it is requisite to wait either till the needle has gone back to the zero point of its scale, or at least until it has assumed a constant deflection attributable to the residue of a current which it is beyond us to eliminate. As soon as this state is attained, the whole of the muscles of one of the arms must be so braced that an equilibrium may be established between the flexors and the extensors of all the articulations of the limb, pretty much as in a gymnastic school is usually done when it is desired to exhibit the development of one's muscles.

As soon as this is done the needle is thrown into movement, its deflection being uniformly in such a sense as to indicate in the braced arm "an inverse current," according to Nobili's nomenclature; that is to say, a current passing from the hand to the shoulder. The braced arm then acts the part of the copper in the compound arc of zinc and copper mentioned above.

With his own galvanometer, and when M. Dubois Reymond himself performs the experiment, the deflection amounts to 30°. He obtains however movements in the needle of far greater extent by contracting alternately the muscles, first of one arm and then of the other, in time with the oscillations of the needle. On bracing simultaneously the muscles of both arms, inconsiderable deviations are observable, sometimes in one direction, sometimes in another; and these minute deflections are evidently attributable to the difference between the contractile force of the two limbs. Hence it arises that when the experiment is

repeated many times in succession, the results diminish gradually in amount, not only in consequence of the energy of the contractions becoming less and less, but also because it becomes more and more difficult to restrain the act of slackening or letting down the muscles to only one of the two arms.

The amount of deviation, *cæteris paribus*, depends upon the amount of the development and the exercise of the muscles. The author is said to have an arm of considerable power, and among the number of savans that have tried the experiment at his residence, there has not as yet been found one who excelled or even came up to him in this respect. There are indeed individuals who do not possess the power of producing a sensible deflection in the needle of his galvanometer, but it is readily ascertained that in these instances there is a want of sufficient muscular tension.

There is one remark, to conclude, which the author has been frequently led to make, namely, that the habitual superiority of the right hand over the left in this experiment is to be interpreted by the preponderance of the amount of deflection produced by the tension of the right arm. This peculiarity was likewise observed when the experiment was performed by M. von Humboldt. The impulsion impressed on the needle by the contraction of the muscles of his right arm was appreciably more considerable than that produced by his left arm.

For his own part, M. von Humboldt has addressed to M. Arago a letter of the following tenor:—He says, the fact of the experiment of affecting a magnetic needle by the alternate tension of the muscles of the two arms, an effect due to volition, is established beyond all question or doubt. Notwithstanding my advanced years and the little strength that I have in my arms, the deflections of the needle were very considerable; but they were naturally more so when the experiment was performed by M. J. Müller or by M. Helmholtz, who are younger men. To facilitate the experiment it is advisable to plunge the fore-fingers into the water, and to support the palms of the hands, to enable one to brace up well the muscles of the arm which it is purposed to bring into play.

2. *On the Development of Electricity in the Act of Muscular Contraction;* by M. Becquerel, (Compt. Rend., May, 1849; Phil. Mag., xxxv, 53.)—I have repeated unsuccessfully the experiment of M. Du Bois Reymond, relative to the production of an electric current in the act of muscular contraction, making use of the arrangements which he indicated in a letter addressed to M. Arago by M. de Humboldt, dated the 17th of May, excluding however, all those secondary causes which could give rise to electric currents, excepting that one, the action of which is described.

I shall commence by recalling to mind the observations which I made in studying the electric effects obtained with a condenser, the plates of which were made of platinum or copper gilt (*Traité de l'Electricité et du Magnétisme*, t. v. 2e partie, page 10):—

"The electro-chemical effects produced on the contact of acid solutions with the liquids which moisten the fingers, must be taken into account. In these various reactions the acids acquire positive electri-

city, which is transmitted to the plate, and the liquids which moisten the fingers negative electricity. With the alkalies the effects are inverse."

It follows from this, that if one of the plates is covered externally by a very thin layer of hygrometric water, and if it is touched with a finger moistened with perspiration, electric effects, resulting from the reaction of the perspiration upon the water, ensue. It is also produced when a finger in a great state of transpiration is applied upon one of the plates, after having been previously moistened with water; in this case the water acquires positive electricity, and the contrary electricity flows into the body of the experimenter. If we add to these effects those which take place when foreign bodies are adherent to the skin, we must conceive that a large number of complex electric effects would be produced in plunging two fingers, as is done by M. Du Bois Reymond, into two capsules filled with water in which are contained two plates of platinum in communication with a multiplier. This is not all: when, in virtue of these various causes, a current has circulated in the liquid and in the wire, the two plates of platinum are polarized in opposite directions, as may be shown by withdrawing the fingers and establishing the communication between the two capsules by means of a siphon filled with the same liquid as that which they contain. This current, during the first few moments, having the same intensity as the primitive current, annuls it; but if, in the act of contraction, the finger of the contracted hand become more or less immersed in water, the inverse current may be less or superior to the direct current. I guarded not only against the effects of the inverse current, but also against the effects resulting from the greater or less immersion of the fingers, by smearing with fat those parts of the fingers which might temporarily come into contact with the liquid. By proceeding in this manner, I found it impossible to observe the effects described by M. Du Bois Reymond.

3. *Note relative to the Electricity developed by Muscular Contraction;* by M. C. Despretz, (Ibid.)—The note which I have the honor of communicating, is a simple enumeration of the experiments which I made with the view of reproducing the phenomena announced by M. Du Bois Reymond of Berlin.* I shall not discuss these phenomena, my only object being to reproduce them. * * * *

The galvanometer which I used was made by M. Ruhmkorff, whose skill is well known. The diameter of the wire was $\frac{1}{10}$th of a millimetre, and its length 300 metres. The wire made about 1800 convolutions round the frame of the apparatus. The delicacy of the instrument is shown by the following numbers.

A copper wire $\frac{3}{4}$ths of a millimetre in diameter, when immersed to a depth of two centimetres, afforded a deflection of 3° in distilled water, 25° in the water of the river Seine, and 68° in a solution of chlorid of sodium, containing from four to five per cent. of the salt.

Plates of gold, the surfaces of which were nearly one square centimetre, afforded under the same circumstances deflections of 11°, 24° and 85°. The gold, which was perfectly pure, had been recently pre-

* Comptes Rendus, May 21; and Phil. Mag., vol. xxiv, p. 453.

pared at the Mint of Paris, in the laboratory of M. Pelouze and M. Peligot. The needle, when set free, took about half a minute in moving from 50° to zero.

I was not at first acquainted with M. Reymond's method of proceeding. In my earliest experiments, two cylindrical conductors were held in the hands, and when the needle had returned to zero, or had acquired a perfectly stationary position, one of the arms was powerfully contracted; the deflection was then observed, and when the needle had again become stationary after the cessation of the contraction, the other arm was strongly contracted, also observing the deflection.

These first experiments were made with common copper conductors. But for the sake of avoiding the objection which might arise from the ready oxydation of this metal, I had them covered with gold-leaf. Other conductors were coated with silver, platinum and gold.

The experiments were made by three persons. Were there no occasion for using galvanometers, we should be inclined to believe that silver, and especially gold and platinum, which preserve their polish and lustre in contact with moist air, would be appropriate for these experiments, on account of their unalterability. This is however not the case; silver, gold and platinum afford currents which are almost as strong as copper. When the platinum conductor is held in the hand, and the needle has become stationary, merely touching it with one finger more, or less, is sufficient to change the position of the needle several degrees.

In these experiments the needle was deflected 50°, 75° and even 90°. When one of the conductors was squeezed powerfully, the needle moved in one direction, and when the other conductor was squeezed, the needle moved in the same or in an opposite direction.

It is indispensable to repeat these experiments several times, without which we should be liable to errors. Thus it happens that the deflections of the needle occur alternately in one and the other direction; but on multiplying the experiments, we find that the deflections frequently take place in the same direction, although the compression is produced first by one and then by the other arm. If the chemical action was regular like that of a watch-spring, we ought to obtain currents in the opposite direction. We only experimented in this way, because, on the one hand, we were unacquainted with M. Reymond's method of proceeding; and on the other, we thought that silver, and especially gold and platinum, when simply held in the hand without any compression, would only afford a very weak current. But experience unfortunately proves that gold and platinum are under these circumstances as *impressionable* as brass, if I may be allowed to use such an expression. I have repeated M. Reymond's experiment several times, both following rigidly and varying his method of proceeding.

I first wished to ascertain whether the instrument, which I had not yet used, was sensible or not to changes of temperature. For this purpose, I heated one of the places at which it was soldered to the melting-point of wax, the communication being established by the hands between the two plates; I also augmented the temperature of one of the two solutions of common salt, by immersing in it glass tubes filled with boiling water, the communication being always kept up by the hands;

in neither case did I observe the slightest deflection, which might be anticipated from the known properties of thermo-electric phenomena; nevertheless it appeared to me of use to verify this in the present instance. To avoid the effect of a more or less deep immersion of the metallic plates, in consequence of the introduction of the fingers, I partly covered these plates with black wax, so that the uncovered surface was always in contact with the solution.

As regards the fingers, I attempted to immerse them to the same extent in all the experiments, having found that in plunging successively one, two or three, or more fingers, or a single finger to a greater or less depth, the intensity of the deflections varied. This result indeed had been anticipated. I had even had some long kinds of copper thimbles gilt, so as to regulate the immersion better. But I abandoned this method of proceeding, because it differed too much from that adopted by M. Du Bois Reymond.

In experiments made according to M. Du Bois Reymond's process, the alternate contraction of each arm has sometimes afforded deflections in the same, sometimes in the opposite direction.

In other experiments, each arm was successively contracted out of the water, and on each contraction the vessels were connected by means of the fingers. In others, large capsules were used, so as to allow more freedom of motion of the hands, and so as to permit the immersion of the closed hands, either contracted or not contracted. The results of these two series of experiments are sometimes favorable, sometimes contrary to the assertion of M. Reymond. The necessity of multiplying the experiments is very distinctly shown in this case. The results of two or three experiments agree with the results announced by M. Reymond; and then, if they are continued, opposite results are obtained. A singular fact is also remarked in these experiments, viz., that the fingers are influenced much in the same way as metallic conductors; they lose part of their efficacy by repeated immersions.

I was desirous of reducing the experiment to a greater amount of simplicity. I replaced the galvanometer by a frog which was properly prepared. Several persons, separately or in connection, having strongly contracted one of their arms, in vain endeavored to produce convulsive movements, by connecting the two arms by means of the most sensible parts of the animal. Nevertheless with a very fine copper wire and a plate of zinc, without the use of any liquid, very marked contractions were produced both before and after the experiment.

I also endeavored in vain to deflect a very delicate astatic magnetic needle, by the union of the two hands, whilst one hand was strongly contracted. Finally, I attached a cylindrical gilt conductor to the back of each hand by silk cord: the contraction of one or the other arm did not perceptibly change the deflection of the needle, which amounted to 10° from the simple contact. The effects of the contact were increased in a marked degree by moistening the back of the hand with a few drops of salt water; but the contraction of one or the other arm did not produce deflections alternately in one or the other directions.

These three experiments appear to me to be under more favorable conditions than those of M. Reymond. The results of them are removed from the intervention of the immersion of metallic laminæ in

saline solutions, which is always somewhat obscure. Unfortunately they only furnished negative results.

In conclusion, if we are only to admit as true that which is clearly demonstrated, we think that the experiments detailed in this note show, that if the contraction of one arm gives rise to an electric current, this current is not appreciable to our present means, at least to those which we have employed.

We are, however, far from believing that the tetanic contraction of a limb does not give rise to the decomposition of a certain quantity of electricity. The friction of the parts upon each other, and the unequally heated state of heterogeneous parts would give rise to electric decompositions; but recompositions ensue immediately. This is probably the case in all the chemical actions which occur in the economy.

Until chemistry has discovered a metal or an alloy which does not afford any current by the contact of liquid conductors, we shall always be exposed to numerous errors in researches upon the currents of animals and vegetables.

The galvanometer is a very valuable instrument, but it requires a very large amount of skill and prudence on the part of the experimenter. If it is made but slightly sensible, it only indicates powerful phenomena; if it is made very delicate, it obeys the slightest perturbating causes. It is not impossible that a large number of experiments upon the currents in animals and vegetables may merely arise from illusions, and that what is attributed to animal and vegetable currents, may be nothing more than the action of liquids upon the plates of gold or platinum of galvanoscopes, or upon other different liquids. If the two plates of gold of a galvanoscope are inserted in any direction in a potato which has either budded or not, in an apple, or a cabbage-stalk, or the flesh of beef; if any two parts of the skin, slightly moist, are touched with these same plates, we have currents; if first one and then the other plate be withdrawn in succession, and after having washed and wiped it, it be replaced, the current is reversed; if the plates are more or less deeply immersed, reversions may also occur.

It is possible that the convulsions experienced by the frog from the contact of the crural nerves with the muscles of the legs, may depend only upon the heterogeneity of the liquids which moisten these parts. It is possible that the permanence of the direction of what is called the current of the frog may be owing to a different alterability of the extremities of the animal by the various solutions employed in these experiments. In the experiment as arranged for determining the true or false current in the frog, we merely require to substitute for the animal a cord of thread impregnated with common salt, and one of the ends of which has been touched with the stopper of a bottle of sulphuric acid, and the other with the stopper of a bottle of nitric acid, to reverse the current a great many times, as is done in the case of the current of the frog.

There is one experiment upon this subject which would have a certain value without being decisive, it is that of the action of a circuit of frogs upon a magnetic needle.

I arranged a chain of frogs in the same manner as the pairs of a voltaic pile are arranged; this chain traversed a bell-glass, beneath which

a very delicate astatic needle was suspended. I did not observe any distinctly appreciable effect at the moment at which I united or separated the extremities of the chain. Had an effect been obtained, the objection from the action of the heterogeneous moist parts would still remain.

It does not appear to me that the existence of electric currents in frogs and plants is a perfectly proved fact. I speak openly, submitting my doubts to those philosophers who have made most interesting, and in some cases very ingenious experiments upon this subject.

4. *On the Polarization of Heat.*—The polarization of heat first announced by Bérard, has been established by various experiments by Forbes and Melloni. Provostaye and Desains have lately announced to the Academy of Sciences at Paris, (Session of July 30,) new investigations showing—

(1.) That heat traversing Iceland spar is divided into two pencils, completely polarized in the plane of the principal section or a perpendicular plane.

(2.) That the law ascertained by Malus, according to which, the intensity of a ray completely polarized is divided between the ordinary and extraordinary images to which it gives origin in traversing the spar, is applicable to heat as well as light.

(3.) That the variations of intensity which polarized heat experiences in its reflexion from glass at different incidences, are exactly represented by Fresnel's formulas determined for light, only allowing that the solar heat traversing the prism has a little different index—1·5.

(4.) That there is a most perfect correspondence between the phenomena presented in the reflection from polished metals of polarized heat and polarized light.

5. *Composition of Bones*, (Acad. Sci. Berlin, Feb., 1849.)—M. W. Heintz, finds for the phosphate of lime in bones, the composition $\dot{R}^3\dddot{P}$, instead of the hypothetical formula $\dot{C}a^8\dddot{P}^3$ of Berzelius. He obtained in his analyses—

	Bones of the ox.	Sheep.	Human bones.	
Lime,	37·46	40·00	37·89	37·51
Magnesia,	30·97	0·74	0·57	0·56
Phosphoric acid,	27·89	29·64	28·27	28·00
Carbonic acid,	3·10	3·08	2·80	2·81
Water, fluorine and organic matter,	30·58	26·54	30·47	31·12
	100·00	100·00	100·00	100·00

Supposing the acids and bases united, adopting the formula given—

Carbonate of lime,	7·07	7·00	6·36	6·39
Phosphate of magnesia,	2·09	1·59	1·23	1·21
" lime,	58·30	62·70	60·13	59·67
Lime,	1·96	2·17	1·81	1·62
Water, fluorine, organic substances,	30·58	26·54	30·47	31·11
	100·00	100·00	100·00	100·00

He thus finds some lime (1·62 to 2·17 per cent.) not combined with the acids detected. This is accounted for by the existence of fluorine in bones, with which this lime is probably united. According to the analyses of Berzelius, the bone of a human thigh contained 3 per cent. of fluorid of calcium, and a bone of an ox 4·25 per cent. out of those portions which resisted the action of heat. Marchand has found in human bones one per cent. of this fluorid, or 1·6 per cent. in the bones when calcined. Heintz, in his experiments, found 2·05 per cent., corresponding to 2·97 per cent. in the bones after calcination. The amount of fluorid of calcium corresponding to the lime found in Heintz's analyses, equals 3·57 and 3·24 per cent. of the calcined material.

Heintz has also found that bones after boiling in water contain no trace of iron. He attributes that found by some chemists to the blood which is not easily removed entirely by cold water.

6. *On the Specific heat of Potassium, with remarks on the equivalents of Silica and the Alkalies;* by V. REGNAULT, (Ann. Chem. Phys. [3], xxvi, 261.)—The author considers the bearing of the law brought out by Dulong and Petit—that the specific heats are in an inverse ratio to the atomic weights—on the equivalents of silver and other elements. He observes that the law holds true for a large part of the elements. Uranium, silver and carbon are three of the exceptions. Uranium has not yet been sufficiently investigated. As to silver, the law alluded to gives an equivalent half of that usually adopted, and would make the oxyd $Ag^2 O$, instead of $Ag O$, and the sulphuret $Ag^2 S$, instead of $Ag S$. The isomorphism of $Cu^2 S$ with the sulphuret of silver, the analogy of chlorid of copper and chlorid of silver, besides other reasons, are urged as favoring a change in the equivalent.

Carbon exists in three conditions, each with distinct specific heats; and it is important to ascertain which of these is its condition in its combinations. It is natural to assume that to be the modification in which carbon is most disaggregated. But the capacity for heat of carbon, as found by Regnault, from the decomposition of organic substances, corresponds to the equivalent 150, instead of 75 the number usually adopted. As an important proof on this point, the author mentions that among a great number of organic compounds whose composition is well determined, the number of the equivalents of carbon *is an even* number. There are two exceptions to this, viz., in the oxyd of carbon (CO), and carbonic acid (CO^2). But there is no special reason for writing CO rather than $C^2 O^2$; and chemists write the formula of carbonic acid CO^2, because they regard as neutral salts, those of most common occurrence,—the carbonates of lime, of baryta, &c., and as bicarbonates, the alkaline carbonates which contain double the quantity of carbonic acid. The anomaly disappears if we adopt the above view and regard the latter as neutral carbonates (as some chemists have actually done), in which case the others are basic carbonates.

The same law as regards the inverse relation of specific heat and atomic weight holds also for compounds. Regnault suggests farther that the alkaline oxyds should have the form $R^2 O$, and the equivalent be halved. Soda and oxyd of silver, or sulphate of soda and sulphate of oxyd of silver, have been known to be isomorphous; and this change would render the composition analogous. With reference to this point,

the author experimented on the specific heat of potassium, and he found it to be 5·40 in his best trial, a result which sustains his conclusion. He hence infers that the equivalent of potassium should be halved, and that the formula of the alkaline oxyds is $R^2 O$.

7. *On Chloroniceic Acid;* by M. E. Saint Evre, (Ann. de Chim. et de Phys., April, 1849.)—This acid is obtained by the action of chlorine upon benzoic acid in the presence of an excess of alkali.

Two hundred parts hydrate potash and 60 benzoic acid are dissolved in 300 water—chlorine is passed until the liquid changes yellow and finally green, with a pulpy deposit. By saturating the excess of potash and boiling, this deposit is dissolved and an oily liquid appears, which floats or sinks, according to the density of the solution, and on cooling, concretes and becomes hard and brittle. Repeated crystallizations first from water and finally from alcohol afford the pure acid.

Chloroniceic acid forms microscopic crystals, which are four-sided prisms; it is volatile without decomposition, the odor is penetrating and resembles that of most chlorinated compounds, being quite different from that of benzoic acid. Distillation with lime or baryta produces a liquid and a solid hydro-carbon; other powerful reagents seem to have no effect.

The formula of the author is $C_{12} H_5 Cl O_4$. Salts of baryta, silver, &c., were formed.

[The formula above given is that of a chlorinated species of *white hydro-quinone*, (Pyroquinol, Ger.) $C_{12} H_6 O_4$, one equiv. of hydrogen being replaced by one of chlorine. That this is the true relation of the so-called chloro-niceic acid, is not surprising, when we remember that Wöhler found benzoic acid and bodies allied to it among the products of the destructive distillation of quinic acid. Benzoic acid moreover differs from hydro-quinone, only by two equiv. of carbon. In the process detailed above, there is oxydation and substitution of chlorine simultaneously carried on. It is true that Hoffman failed to obtain chloranile from benzoic acid by chromate of potash and muriatic acid; but from the reaction above mentioned, it would appear that the product should have been a quadri-chloro-hydro-quinone, which is in reality colorless and might well have been overlooked.

But we have more conclusive evidence of the correctness of our opinion in the researches of Dr. Staedeler, (more particularly noticed below,) in which he has proved the existence of several chlorinized species of hydro-quinone—in fact of all but this very one which he does not seem to have formed; his process, however, was a totally different one. As it is, the description of the others will answer almost word for word for this, which should be called *monochloro-hydro-quinone*, a name somewhat longer than that given by the discoverer, but which has the advantage of expressing at once the relation to twelve different allied bodies. G. C. Schaeffer.

8. *On the Chlorinated Products of the Decomposition of Quinic Acid;* by Dr. G. Staedeler, (Liebig's Ann., March, 1849.)—It is well known to chemists that by distilling quinic acid with sulphuric acid and peroxyd of manganese, a substance called quinone, $C_{12} H_4 O_4$, is formed, which is very singular in its properties and reactions. Under the influence of an excess of reducing agents, e. g., sulphurous acid—two equiv.

of hydrogen are taken up, forming hydro-quinone $C_{12} H_6 O_8$. By the union of the two substances, the first yellow, the second colorless, an intermediate body, green hydro-quinone ($C_{12} H_5 O_4$) is found; this substance has been represented as the most beautiful known to chemists, excelling murexide in its rich metallic golden green crystals; they are formed of great size even in a small quantity of solution.

Dr. Staedeler has formed chlorinized species both of quinone and of hydro-quinone, in all cases the former being yellow and the latter colorless. In one instance the union of the two formed a substance intermediate in composition and of equal beauty with green hydro-quinone. Of the quinones, we have according to our author, 1, 2 and 3 equiv. of H replaced by Cl; four equiv. replaced in the well known chloranile.

Of the hydro-quinones, one equiv. is replaced in the chloro-niceic acid [see above], the others were formed by the action of sulphurous acid on the corresponding quinone; the most remarkable is that formed from chloranile, as by means of it the true relation of that substance to quinone is demonstrated.

Some other compounds are described by the author, although of no particular interest. Wöhler has also recently reviewed his investigation of the sulphur compounds of the series. He finds that in some instances there is direct union with S H. G. C. S.

9. *Volatilization of Carbon;* by C. Despretz, (Compt. Rend., 1849, 48.)—M. Despretz has commenced a series of experiments on the fusion and volatilization of various refractory substances. As one of his first results, he announces the fusion and volatilization of carbon. He used a battery of 496 elements in four parallel series. Carbon from sugar in an "œuf electrique" was subjected to its action; a high degree of incandescence was produced, and the globe was covered with a black powder, dry and crystalline. After many precautions to test the reality of the result, and various changes in the mode of experiment, Despretz satisfied himself that the effect was owing to a volatilization of the carbon. In one case, when the carbon reached a white heat, some white traces were deposited on the sides of the vase; then suddenly it was reduced to a state of vapor, with nearly the appearance which iodine presents when a fragment is cast on a heated body. The glass was lustrous with the crystalline sublimate. This result failed with less than 496 elements.

Experiment has farther shown that carbon is best fused into globules in nitrogen under a pressure above the ordinary atmospheric pressure. Glass vessels break too easily, and therefore it is necessary to use metallic.

Alumina, rutile, anatase, nigrine, oxyd of iron, kyanite and other species were fused immediately into globules and then gave off vapors. Despretz has this subject still under investigation.

[Note.—The fusion and volatilization of carbon by Prof. Silliman, was long since announced in this Journal, (see vols. v, 108, 361, vi, 341, 378, x, 109, 119, 1822–1826.) The condensation of carbon upon the inner surface of a globe has been a frequent class experiment with Prof. S., and it has been customarily mentioned in his lectures as a case of vaporization. The battery used in the Yale College Laboratory con-

sists of 900 pairs, and is one of the largest ever constructed. The same result may be obtained by a Bunsen's battery of 60 pairs, as Prof. Silliman, Jr., has often observed. The experiments of Professors Silliman and Hare extended to the melting of various refractory substances, which had never before been fused.]

10. *On the Atomic Weight of Silica;* by H. Kopp, (Liebig's Annalen, lxvii, p. 356, in Chem. Gazette, July, 1849.)—The doubts entertained respecting the atomic weight of silicon and the composition of silica according to one of the three formulæ SiO, SiO^2 or SiO^3, have not been solved by the views which have hitherto prevailed on this subject, where in general the decision has been made to depend on the circumstance, that a particular series of compounds might be most simply represented, sometimes according to one, sometimes according to the other formula. A peculiar mode of conceiving this subject shows that, admitting the correctness of the analytical results of Pelouze, the atomic weight of silicon with H=1 is 21·3, and the formula of silicic acid SiO^3.

Kopp has deduced this result from the difference between the boiling-points of the chlorid and bromid of silicon. The possibility of deciding the question by this means is sufficiently evident from a number of determinations of the differences between the boiling-points of several chlorids and bromids, in which the chlorine, on the one hand, may be regarded as a substitute for the bromine in the otherwise corresponding bromid, thereby establishing how many degrees the boiling-point rises or falls when in any compound chlorine is replaced by bromine, or *vice versâ* bromine by chlorine. After establishing the number of degrees which express this difference for the substitution of each atom of chlorine or bromine, it is possible, on the other hand, to conclude, from the difference between the boiling-points of a chlorid and the corresponding bromid, as to the number of atoms replaced. Now it results, from the comparison of the boiling-points of several bromids and chlorids, that the substitution of 1 Cl by 1 Br raises the boiling point 32° Cent. of 2 Cl by 2 Br $2\times32=64°$ of 3 Cl by 3 Br $3\times32=96°$, while the boiling-point falls in the same proportion when, on the contrary, bromine is replaced by chlorine. Compare, for example, the boiling point of the following substances:—

		Boiling-point.
C^4H^5Cl	Chlorethyle . . .	+11°, Pierre.
C^4H^3Cl	Chloracetyle . . .	−18° to −15°, Regnault.
PCl^3	Chlorid of phosphorus .	78°, Dumas, Pierre.

		Boiling-point found.	Calculated.
C^4H^5Br	Bromethyle . . .	41° Pierre.	43°.
C^4H^3Br	Bromacetyle . . .	Ord. temp.	14° to 17°.
PBr^3	Bromid of phosphorus .	175°, Pierre.	174°.

Several other comparisons enumerated by Kopp lead to the law above announced respecting the change in the boiling-point in substitutions of bromine and chlorine. It consequently follows, as above stated, that according as the boiling-point of a bromid, on comparison with that of its corresponding chlorid, is situated at 32, 64 or 96 degrees higher than in the chlorine compound, this latter must be regarded as contain-

ing 1, 2, 3 atoms of chlorine replaced by bromine. The boiling-points of the chlorid of silicon and of the bromid of silicon have been determined by Pierre, a most accurate observer, the first to be 59°, the latter to be 153°; the difference is 94°; whence it follows that in the bromid of silicon 3 atoms of bromine are substituted for 3 atoms of chlorine in the chlorid of silicon; that the first is $SiBr^3$, the latter $SiCl^3$, and that silica is therefore SiO^3; and consequently we must admit the atomic weight of silicon to be 21·3, H being assumed =1.

II. Mineralogy and Geology.

1. *Notes on the California Gold Region;* by Rev. C. S. Lyman, (in a letter to one of the editors, dated Puebla de San Josè, March 27, 1849.)—From the western base to the summit of the range of the Sierra Nevada, is a distance generally of a hundred miles, or more. The western slope is broken and precipitous, and through the deep ravines that abound, flow the numerous mountain streams that form the tributaries of the Sacramento and San Joaquin rivers. The gold region is a longitudinal strip or tract from ten to forty miles in width lying about midway, or a little lower, between the base and summit of the range, and extending in length a distance of many hundred miles—active operations being already carried on through an extent of four or five hundred miles at least. The gold mines near San Fernando in a spur of the same range and which have been known and worked to some extent for many years, are doubtless a part of the same great deposit.

On approaching the gold region from the valley of the Sacramento or San Joaquin, soon after leaving the plain, the attention is arrested by immense quantities of quartz pebbles, slightly rounded, and of the size of walnuts, scattered over the gentle elevations which form the western base of the Snowy Mountains.* There is here but little soil—the earth is of a yellowish red color, and nearly destitute of vegetation. Nearer to the gold deposits the quartz pebbles become larger, and not unfrequently boulders are noticed of considerable size. The quartz is so uniformly associated with the gold, that even the most unscientific explorer would not think of looking for the metal where quartz did not abound. Passing up the mountains it is easy to tell when you leave the region of gold from the sudden disappearance of the quartz. In August of last year, in company with Mr. Douglass and others, I ascended from the "Dry Diggings" near the Rio de los Americanos, to within a few miles of the snow, enjoying in the highest degree the sublime scenery presented by lofty and precipitous mountains, separated from each other by dark, deep ravines, and wooded with primæval forests of towering firs and pines. The back bone of this mountain range is granite, the several varieties of which constituted almost the only rock visible in the last few miles of our journey. In descending we passed successively several forms of gneiss and other primitive and transition rocks, till we reached the slate formation which prevails in this part of the gold district. We penetrated on this occasion some forty or forty-five miles beyond the "dry diggings," and after leaving the quartz twelve or fifteen miles up, scarcely a particle of gold was discovered.

* See observations by J. D. Dana, [2], vii, 257, 261.

As I have mentioned, the prevailing rock of the gold region near the Rio de los Americanos is slate. There are many varieties of it—some shaly and friable, others hard and massive, somewhat resembling greenstone. The laminæ of the slate beds are nearly perpendicular, and their direction about N.N.W. and S.S.E., or nearly the same as the direction of the range. These slate beds often include dykes or beds of quartz rock several feet in thickness. At the dry diggings above named, I passed at right angles over the upturned edge of continuous strata of slate a distance of four or five miles; and in the same direction, slate beds occur several miles farther on, but I had not the means of knowing that they were a part of the same great deposit.

In some of the richest explorations yet made, this slate formation immediately underlies the stratum of drift or diluvium which contains the gold, and much of the gold is found in the crevices of the slate, the rough edges of the upturned strata forming innumerable receptacles or "*pockets*," as they are called, into which the metal has originally found its way, from its own gravity assisted by aqueous agency. It is this accidental association of the gold with the slate rocks which has caused the statement to be frequently made, even by persons of much general intelligence, that the gold exists in the body of the rock itself, and forms a component part of it, in the same sense that iron pyrites forms a part of the rocks in which it occurs. But I have nowhere seen gold among the slate, except in circumstances where its presence could be accounted for by its introduction from without, a close scrutiny readily discovering some cleft or opening through which it might have entered. The richest of these "pockets" are in the bottoms of sharp ravines which seem to have been notched into the body of the slate, and generally in situations where the bottom of the ravine, after descending at a considerable inclination for some distance, becomes more nearly horizontal. Just below a sudden descent or precipice, in the bottom of a dry ravine, gold is often found in the cavities in great abundance. From such a spot Mr. Douglass extracted a pound of gold in a few hours, even after the place had been previously "dug out," as was supposed, and abandoned.

I have noticed in published accounts, many erroneous statements respecting the geological position of the gold. Some have said there is no particular formation in which the gold occurs—but that in different places it is found in different kinds of earth or rock. You will not need to be informed that this is without foundation. So far as I have been able to examine, or can learn from competent witnesses, there is but *one* geological formation with which the gold of the Sierra Nevada is associated and in which it uniformly occurs. This is the stratum of *drift* or *diluvium*, composed of a heterogeneous mixture of clay, sand, gravel, and pebbles, and varying in thickness from a few inches to several feet. Here, as elsewhere, this stratum is neither horizontal nor of uniform slope, but conformed to the varying inclination of the earth's surface, covering the declivities, and even the summits of the hills, as well as the bottoms of the ravines and valleys. Out of this stratum I have no where found gold, except where a stream has cut it away and made its contents a part of some alluvial formation of comparatively modern date. The sandbars of some of the mountain torrents, and the grav-

elly projections formed at the bendings of the streams, are often extremely rich in metal. A bar in the Rio de los Americanos, (at high water an *island*,) about twenty-three miles above New Helvetia (now called Sacramento) and on which some of the earliest explorations were made, is of this character. But where the diluvium has remained undisturbed since the period of its deposition, I am confident no "alluvial" or "stream" gold has been, or will be discovered, except in connection with it. It is evidently as much "part and parcel" of this formation as its associated quartz, greenstone, hornblende, and other pebbles, and whoever will explain the origin of the one, will at the same time elucidate the origin of the other—for one and the same agency unquestionably spread both of them over the surface of the district. What the latest theory of geologists is to account for the dispersion of drift, I am too isolated from the scientific world to know. Quartz is the only substance with which I have seen the gold intimately united, and these compound lumps seem to show clearly that the original *matrix* or *vein-stone* of the metal was a dyke or bed of quartz rock. And we have only to suppose, that when the quartz, with its accompanying rocky strata, was broken up by natural agencies at some former geological epoch, the interspersed or included veins of gold were at the same time reduced to fragments, and these rough and angular fragments subsequently broken and further comminuted and rounded by mutual attrition, to account for the present form and appearance of the gold, and for its constituting a portion of the materials of the drift. But whether these materials with their golden treasure, now occupy the precise geographical position of their parent rocks, or whether they have been transported by aqueous or glacial agencies or both, from some neighboring or perhaps far distant locality, is a question which future investigations into the geology and physical geography of the region will better elucidate than the imperfect data at present in my possession. I cannot avoid the fancy, however, in connection with the glacio-aqueous theory, that when the continent was wholly or partially submerged, the materials of the diluvium, including the gold, were transported by icebergs from their parent locality, and when at length set free, left to assume their present position on what was then the rocky and uneven bottom of the superincumbent ocean. And we have only to imagine these freighted icebergs stranded by oceanic currents against the partially emerged range of the Sierra Nevada, to account for the great longitudinal extension of the gold region along the western slope of the mountains, while laterally it appears to extend neither above nor below certain definite limits.

The gold of different localities varies very much in size. That from the banks and sandbars of the rivers, is generally in the form of small flattened scales, and commonly it is found to be finer the lower down you descend the stream. That taken from the bottoms of the dry ravines, which every where abound in these mountains, and furnish outlets for the torrents of the rainy season into the principal streams, is mostly of larger size, and occurs both in small particles and also in small lumps and irregular water-worn masses, from the size of wheat kernels to pieces of several ounces or even pounds in weight. The fine gold of these ravines is commonly less worn and flattened than

that in the alluvion of the rivers. And the flattened scale-like form of the gold in these latter deposits would seem to be owing to the great malleability of the metal—the stones and pebbles among which the minuter particles and fragments of the original vein of native metal chanced to lie, and by which they were rudely hammered, having performed very effectually the gold beater's office, and gradually reduced the rough angular particles, on their granite anvils, to the flattened spangles which we now observe. Some of these flakes are often an inch or more in diameter and scarcely thicker than paper. Many specimens bear the distinct impression of the crystalline structure of granite and other rocks; and I have seen several pieces deeply stamped, as with a die, by crystals of quartz, the form of the crystal being as distinctly apparent as the device on a gold eagle fresh from the United States mint.

The black, ferruginous sand, which every where accompanies the gold, and which, from its great specific gravity, remains with it in the bowl or machine after the other earthy materials have been removed, varies in fineness with the size of the accompanying gold. That obtained in connection with the fine river gold being of the fineness of writing sand, while that associated with the coarse gold of the ravines is often as large as wheat kernels, or peas, and sometimes of the size of hazelnuts or walnuts. These coarser pieces are fragments of crystals very hard and heavy. I found no specimens with the faces complete, and have not the means of knowing to what species they belong, but suppose them to be magnetic iron. That the fine sand is composed of fragments of the same crystals greatly comminuted, I infer from the regular gradation of the one into the other.

I am not aware that the gold has yet been discovered *in place*, or imbedded in its native matrix. The slates, however, of the gold region, as I have before observed, are often traversed by dykes or beds of quartz rock, and I have examined these in many places for indications of the presence of the metal, but could detect no traces of it. Individuals have asserted that they have found veins of it in the rocks, but they have refused to divulge the place where, inasmuch as they intended to work the veins themselves as soon as the season would permit. Though these statements are of course not impossible nor indeed improbable, I do not consider the fact as established by testimony, since the witnesses are men in whom I place but little confidence.

The amount of gold taken from these mines it is impossible to estimate, but it has been immense, and the coming season it will doubtless be greater. New and rich deposits are developing every day. Accounts from various points in the mining district, represent the gold as very abundant, more so if possible than last year—individuals even that early in the season obtaining often from three to ten or even twenty ounces a day. The diggings on the several forks of the Rio de los Americanos, the Stanislaus, the Tuwalumnes, the Merced, the Mariposa, King's river (Lake Fork on Fremont's new map), and in many other places, are represented as peculiarly rich.

There was one specimen of gold mingled with quartz, found near Stanislaus last autumn, which I had resolved to procure if possible, for the cabinet of Yale. It was irregular in form, about four inches in diameter, and weighed 5¼ pounds avoirdupois. The metal was inter-

spersed in irregular masses through the stone, and as near as I could judge without special investigation, was equivalent to about two pounds troy, perhaps a little more. Other specimens much larger, are said to have been found, and one of 20 pounds weight pure, near the Stanislaus; but these I have not seen.

2. *Geographical Survey of Tennessee.*—The geographical survey of Tennessee, under Dr. Troost, is still in progress, and is bringing to light many valuable additions to science, besides developing the various resources of the state. Prof. Troost is well known for his learning, his skill, and his enthusiasm in his investigations, and it is greatly to the honor of Tennessee, that such a savant is appreciated and his talents called into action. In a recent communication from Dr. Troost, he mentions that the number of the new genera and species of Crinoidea which occur in the state of Tennessee is really surprising. His Geological Report now before the legislature of the state of Tennessee, contains a monograph of Crinoidea of that state, in which 16 new genera and 88 new species are described, illustrated by 220 figures; this number not only surpasses that of those discovered in the other states of the Union, but perhaps is equal to those that have been found over the whole of Europe.

The list which he communicates is as follows:—

1. Cidaris Tennesseæ, T.
2. Asterias antiqua, T.
*3. Astrios Tennesseæ, T.
4. Melonites multipora, *Norwood* and *Owen.*
*5. Campanulites tesselatus, T.
*6. Catillocrinites Tennesseæ, T.
7. Cariocrinites meconideus, T.
8. —— hexagonus, T.
9. —— granulatus, T.
10. —— insculptus, T.
11. —— globosus, T.
12. Pentremites pyriformis, *Say.*
13. —— Tennesseæ, T.
14. —— florialis, *Say.*
15. —— —— elongatus, *varietas.*
16. —— Cherokeus, T.
17. —— Reinwardti, T.
*18. Olivanites Verneuli, T.
19. —— globosus, T.
*20. Cacabocrinites sculptus, T.
*21. Codonocrinites gracilis, T.
22. Echinocrinites fenestratus, T.
23. Actinocrinites moniliformis, Miller.
24. —— Humbolti, T.
25. —— gibbosus, T.
26. —— Agassizi, T.
27. —— Urna, T.
28. —— Nashvillæ, T.
29. —— cornutus, T.
30. —— fibula, T.
31. —— Verneuli, T.
*32. Balanocrinites sculptus, T.
33. Heterocrinites simplex, *Hall.*
*34. Agaricronites tuberosus, T.
*35. Conocrinites tuberculosus, T.
36. —— Leæ, T.
37. Eucalyptocrinites splendidus, T.
38. —— ovalis, T.
39. —— extensus, T.
40. —— lævis, T.
41. —— Phillipsii, T.
42. —— Goldfussi, T.
43. —— Nashvillæ, T.
44. —— conicus, T.
45. —— Tennesseæ, T.
46. —— gibbosus, T.
47. Gilbertsocrinites Americanus, T
48. Cyathocrinites inflatus, T.
49. —— stellatus, T.
50. —— gracilis, T.
51. —— corrugatus, T.
52. —— Tennesseæ, T.
53. —— planus? *Miller.*
54. —— robustus, T.
55. —— crateriformis, T.
56. —— globosus, T.
57. —— depressus, T.
58. —— tiariformis, T.
59. —— sculptus, T.
60. —— conglobatus, T.
*61. Zeæcrinites magnoliiformis, T.
62. Poteriocrinites municipalis, T.
63. Synbathocrinites Tennesseæ, T.
64. —— granulatus, T.
*65. Cupellæcrinites Verneuli, T.
66. —— lævis, T.
67. —— striatus, T.
68. Buchii, T.
69. —— magnificus, T.
70. —— corrugatus, T.
71. —— stellatus, T.
72. —— rosæformis, T.
73. Cupellæcrinites pentagonalis, T.

74. Cupellæcrinites inflatus, T.
75. Haplocrinites hemisphericus, T.
76. —— ovalis, T.
77. —— granulatus, T.
78. —— maximius, T.
79. Platycrinites Ann Dixoni, T.
80. —— Huntsvillæ, T.
81. —— polydactylus, T..
82. —— insculptus, T.

*83. Donacicrinites simplex, T.
*84. Dæmonocrinites cornutus, T.

Astylocrinites.

*85. Crumenæcrinites ovalis, T.
*86. Agassizocrinites dactyliformis, T.
87. —— gracilis, T.
*88. Granatocrinites cidariformis, T.

Those marked with * are new genera.

We may confidently believe that the state will bring out the results of the survey in the most liberal manner, with full illustrations.

3. *On the Altered Dolomites of the Island of Bute;* by JAMES BRYCE, (Phil Mag., 1849, [3], xxxv, 81.)—Mr. Bryce describes examples of magnesian limestone beds, intersected by dykes of greenstone. The limestone is rendered saccharine in texture, having a crumbling character adjoining the dyke, but hard a short distance off. By analysis, it was found that the unaltered rock contained 20 per cent. of carbonate of magnesia, while the part altered by the dyke contained only 1 to 3 per cent. The following are analyses made under the direction of Dr. Robert D. Thomson.

		Si and Al	Fe	Ca C	Mg C	
1.	Altered,	6·91	1·68	90·65	1·00	=100·24
2.	"	5·70	1·28	91·08	1·17	= 99·23
3.	" hard	1·94	0·52	96·48	1·23	=100·17
4.	"	0·28	0·56	96·58	2·24	= 99·66
5.	unaltered,	9·70	1·12	67·42	17·31, H, C, and coaly matter	4·45=100
6.	"	9·08	1·12	67·00	18·06 " "	4·74=100

The material for the first two analyses was that nearest the dyke and most altered. The author enquires, "To what cause are we to assign the changes that have taken place? Has the magnesia been sublimed by heat; or has it been withdrawn by the solvent power of free carbonic acid?" "The subject is one of great interest both to the geologist and chemist, as the facts are directly opposed to the received views, and as no instance of similar changes on dolomitic rocks has, so far as I am aware, been put on record."

Associated with the trap of the island of Bute, there are beds of lignite, in some cases three feet thick, and consisting of hard, stony coal. The lignite rests upon a tufa and is overlaid by an ochreous layer and then by trap or greenstone.

4. *Plumbic Ochre from Mexico.*—We have received from Prof. BAILEY of West Point, specimens of plumbic ochre, or native litharge, from New Mexico. He writes concerning it:—"It was given to me by Maj. Geo. Thomas, of U. S. Army, who got it in New Mexico, where he said it was called 'silver flux,' and used in working silver ores. Thinking it might be only an artificial 'litharge,' I wrote to Major Henry for particulars, and he says, 'I am certain that it is obtained in many places in the province of Chihuahua and Cohahuila. Whilst stationed at Saltillo I saw some forty or fifty sacks of it which had been taken from a mine near Mazapel, a mining town, some 100 miles south of Saltillo. I saw a few pieces which had been picked up by officers in the streams between Ceralvo and Monterey, and also in the Sabinas

river in the province of Cohahuila. This leads me to suppose this ore occurs in the range of mountains running nearly north and south through Cohahuila and terminating about twenty-five miles north of the city of Monterey.'"

We have examined the specimens sent us by Prof. Bailey, and find them to be the yellow oxyd of lead. The color is between orpiment and sulphur yellow, and it glistens like a granular mica of a nearly golden color. The natural surface is slightly crystalline and shining, and when broken it has a scaly texture.

5. *On the Formation of Minerals;* by M. H. DE SENARMONT, (Compt. Rend. Acad. Sci., Paris, June, 1849.)—Senarmont by keeping certain solutions under pressure at a temperature somewhat elevated, has been enabled to form several carbonates. The material is placed in a glass tube afterwards hermetically sealed, and a uniform heat is sustained by putting the tube in a small chamber or oven. For high temperatures the tubes were strengthened and the pressure equalized by placing them within a gun barrel, which was half filled with water and sealed up. In this way he formed—

Carbonate of Magnesia from sulphate of magnesia and carbonate of soda; temperature about 160° C. It was in the state of white crystalline grains, hardly attacked by the acids.

Carbonate of Iron from sulphate of protoxyd of iron and carbonate of soda; temperature 150° C. and above. Also, from protochlorid of iron and carbonate of lime; temperature between 130° and 200° for twelve, twenty-four, and thirty-six hours.

Carbonate of Manganese from chlorid of manganese and carbonate of soda; temperature about 160° C. Also, from chlorid of manganese and carbonate of lime; temperature between 140° and 170° C. for twelve to forty-eight hours.

Carbonate of Zinc from a process like that for carbonate of iron.

6. *On the Decomposition of Rocks;* by M. M. EBELMEN, (Ann. des Mines, [4], xii, 627.)—The following are M. Ebelmen's results with a trap from near St. Austle, (Cornwall.) This trap consists essentially of labradorite and pyroxene.

	Trap unchanged. A.	Altered Trap. B.	Trap more altered. C.
Alumina,	100	100	100
Silica,	325	212	201
Lime,	36	5	6
Magnesia,	17	14	12
Oxyd of iron,	106	107	79
Oxyd of manganese,	3	2	
Potassa,	33	14	13
Soda,			
Water,	11	43	38
	631	497	449

Hence the trap by decomposition has lost more than a third of its silica, $\frac{2}{3}$ of the lime, and half of the alkalies; this last shows that the feldspar was the last to change and had not been wholly decomposed.

A basalt from the Rhine consisting of labradorite about 54 p. c., pyroxene 24, chrysolite 10, with titanic iron 10, and water, 2 p. c., afforded him—

	Unchanged Basalt. A.	Basalt altered. B.
Alumina,	100	100
Silica,	283	228
Lime,	63	43
Magnesia,	39	29
Oxyd of iron and manganese,	80	78
Titanic acid,	6	6
Potassa,	7·4	2·6
Soda,	22·2	7·4
Water,	15·0	35·0
	615·6	529·0

Here two-thirds of the alkalies have disappeared, showing that the decomposition of the feldspar was far advanced. The result of the changes in both cases is to produce as the residue, a hydrated silicate of alumina or a clay. The removal of the silica is shown by M. Ebelmen to be independent of the alkalies present. The decomposition is attributed by him to carbonic acid and oxygen present in waters, to organic matters living or in course of decomposition, and the phenomena of nitrification.

7. *Phosphate of Lime in Greensand and Marl*, (from De la Beche's Address to Geol. Soc., London, Proc. Geol. Soc., May, 1849, p. lxxxii.) —The agricultural importance of phosphate of lime has of late years caused more search to be made for this substance than formerly, though its occurrence as a component part of certain organic remains and of some rocks has been long known. Mr. Paine, of Farnham, having pointed out that certain beds contained phosphate of lime in sufficient abundance to render them of much agricultural value, our colleague, Mr. Austen, was induced to investigate the mode of occurrence of the phosphate of lime in his own neighborhood, that of Guildford. He found that the phosphate of lime nodules are abundant in the upper greensand. They also occur in the gault, in two distinct beds, remarkably persistent in the district. In describing the position of these beds, Mr. Austen takes occasion to point out the inaccuracy of the published geological maps and sections of the district, calling attention to the beds of very different parts of the cretaceous series which are brought up along the escarpment of the North Down range. Having ascertained the facts connected with the layers of phosphate of lime nodules in the vicinity of Guildford, Mr. Austen examined the neighborhood of Farnham, and found the component parts of the cretaceous series the same as near Guildford, with the exception that sandstones, occasionally cherty, represent near Farnham the firestone on the eastward and the malm rock on the west, differing however from them in containing scarcely any carbonate of lime. This Mr. Austen infers to have happened from a stream of water, having a course somewhat north and south, drifting rather coarse materials with little calcareous matter in this locality.

Mr. Austen regards the phosphoric acid of the nodules as of animal origin. When the nodules are rubbed down they present a concentric arrangement of parts, resembling bodies formed, like agates, by infiltration into cavities; and our colleague points out that, where the casts of bivalve shells and ammonites are filled with matter containing phosphate of lime, these forms must have been first inclosed in the sand, that then the proper shelly matter was removed, and finally that the earthy phosphate occupied the place of the hollow. He supposes that the phosphoric acid may have formed part of the coprolitic matter of the time, this matter in part preserved with its original external form, while more frequently it was broken up and the component portions diffused amid the sand and ooze. He also draws attention to the conditions to which the beds containing these substances have been exposed since their formation, having been covered by thick deposits and having descended to depths beneath the level of the sea, where they were exposed to an elevated temperature corresponding with the depth and the amount of bad heat-conducting bodies above them, so that many chemical changes were effected, and among them a more general diffusion of phosphoric acid in the mass.

Mr. Nesbit has also communicated to us some remarks on the presence of phosphoric acid in the subordinate members of the cretaceous series. He states that he mentioned to Mr. Paine, in November, 1847, the existence of a large amount of phosphoric acid in a fertile Farnham marl, and that he subsequently obtained 28 per cent. of phosphoric acid from portions of this marl, the general mass containing about 2 per cent. Nodules from the Maidstone gault also gave him 28 per cent. of phosphoric acid. Other localities are noticed, and as much as 69 per cent. of phosphoric acid is mentioned as contained in a dark red sandstone rock occurring in masses in the upper portion of the lower greensand at Hind Hill.

Mr. Wiggins has sent us a notice of the fossil bones and coprolitic substances discovered in the crag of Suffolk, remarking on the value of the latter for agricultural purposes, 200 tons of them having been obtained from about a rood of ground,—an additional instance of the remains of animals and their fæces entombed in rocks of different geological ages becoming available for the growth of existing plants.

As regards phosphate of lime and its dissemination, which modern researches have shown is much greater, when sufficient quantities of rocks are examined, than appeared from the analyses of the small portions usually employed,—a matter of interest when we consider the phosphate of lime required for certain plants,—we should recollect that when free carbonic acid is present in water, the phosphate, like carbonate of lime, though not to the same amount, is very soluble. Hence, especially when, as noticed by Mr. Austin, phosphate of lime is disseminated in the state of fresh coprolites amid detrital matter, and water containing free carbonic acid is present and can have access to it, the phosphate of lime would be in a condition to be removed and disseminated. Mr. Austen has alluded to the mixture of such bodies with vegetable matter, to the decomposition of which, with animal matter also, we might look for some, at least, of the carbonic acid that would aid the solution of the phosphate of lime. As in the case of

the carbonate of lime previously noticed, when the solution of this phosphate met with the silicates of potash or soda, whilst percolating amid the rocks, the silicates would be decomposed by the carbonic acid, and the phosphate of lime thrown down. We should expect,—in the same manner as carbonate of lime often replaces the origimal matter of a shell which has been decomposed and removed from the body of a rock, leaving those cavities commonly termed casts,—that phosphate of lime, in localities where from accidental circumstances it was somewhat abundantly filtering through rocks, would also enter these and other cavities, filling them under the needful conditions of deposit. In like manner as we find carbonate of lime separating itself from mud and silt in which it was disseminated, forming the nodules so common in calcareo-argillaceous deposits, should we also expect disseminated phosphate of lime to do the same under fitting conditions; so that it would not necessarily follow, however true in numerous cases, that nodules containing much phosphate of lime were coprolitic. We can readily imagine circumstances very favorable for the solution and spread of these phosphates amid layers of mud and silt. We find such phosphates surrounding some fossils, such as crustaceans from the London clay, leading us to infer a connexion between the animal matter and this substance.

8. *Arkose*, (Bib. Univ., March, 1848.)—The arkose of the Vosges, according to Delesse, is a metamorphic quartzite, consisting essentially of hyaline quartz and crystals of orthose (feldspar.)

III. Zoology.

1. *Conspectus Crustaceorum, &c.*, Conspectus of the Crustacea of the Exploring Expedition; by J. D. Dana,—continued.

CRUSTACEA ISOPODA.

Appendices abdominales, duobus posticis exceptis, plerumque branchiiformes, stylis caudalibus duobus aut nullis. Pedes thoracis 6 antici ad eandem seriem pertinent, 8 postici ad seriem alteram,* exceptionibus raris (in *Isopodis brachiatis.*)

I. ISOPODA BRACHIATA.

Pedes seriei posticæ sex.†—Species Amphipodis affines (præcipuè Dulichiis); habitum Caprelloideæ; sæpius algas, corallinas, etc. a pedibus sex posticis affixæ cum corpore arrecto.

Familia 1. Arcturidæ. (Idotæoideæ.)

Pedes sex postici inter sese unguiculati similes.—Abdomen pauciarticulatum, laminis operculiformibus infra opertum (sicut Idotæis), stylis caudalibus carens.

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* Amphipodis (etiam Isopodis rarissimis) series antica *octo* pedes, et *sex* postica; quoque, styli caudales *sex*, et alii appendices abdominales *natatorii*. Hæc discrimina optima et non negligenda.

† Hâc charactere species illæ aliis Isopodis remotæ et Amphipoda osculant.

Genus 1. LEACHIA,* *Johnston.*—Pedes 8 antici ciliati, non unguiculati. Antennæ superiores perbreves, 4 articulatæ; inferiores longæ, pediformes, ungue 1–3 articulato confectæ. Segmentum thoracis quartum prælongum.

LEACHIA NODOSA.—Corpus tuberculosum. Segmentum thoracis quartum valde elongatum anticè latius et utrinque cuspidatum. Abdomen 2-articulatum, segmento primo transverso, secundo oblongo, prope apicem latiore, posticè rotundato, prope basin utrinque emarginato. Antennæ superiores tenues, articulis duobus inferiorum primis parce longiores; inferiores pediformes, 6-articulatæ, fere corporis longitudine, articulo quinto breviore quam quartus, sexto (ultimo) brevi, unguiformi, fere recto, infra parce setuloso.—Long. 6‴.

Hab. prope insulas Mangsee in freto Balabac.

Familia 2. TANAIDÆ.

Pedes 2 antici, manu validâ instructi, reliqui unguiculati, mediocres, sex posticis inter sese similibus. Abdomen 5–6-articulatum, appendicibus decem subnatatoriis, stylis caudalibus articulatis.

Genus 1. TANAIS, *Edwards.*—Corpus lineare. Caput perbreve. Segmentum thoracis primum oblongum. Antennæ quatuor, breviusculæ, superiores flagello non confectæ. Abdomen 5–6-articulatum. Pedes antici breves, crassè cheliformes.

1. TANAIS BRASILIENSIS.—Pedes antici crassi, manu ad basin paulo angustiore, pollice non crassiore quam digitus. Antennæ primæ paulo majores, corpore quadruplo breviores, 5-articulatæ; secundæ 6-articulatæ, articulis duobus basalibus paulo crassioribus. Abdomen 6-articulatum, posticè rotundatum et medio apiculatum, segmentis subæquis, ultimo non majore, ad apicem apiculato. Styli caudales 6-articulati. Segmentum thoracis septimum sexto brevius.

Hab. in portu Rio de Janeiro.

2. TANAIS ELONGATUS.—Gracilior. Pedes antici crassi, manu ad basin non angustiore, pollice crassiore quam digitus intus angulato et setam gerente. Antennæ primæ 4-articulatæ; secundæ 4-articulatæ, paulo breviores. Abdomen pubescens, 6-articulatum, posticè rotundatum, segmento ultimo majore, semicirculari. Styli caudales biramei ramo longiore 2-articulato, altero 1-articulato. Segmenta thoracis quatuor postica subæqua, fere quadrata.

Hab. in mari Sulu.

Genus 2. LEPTOCHELIA, *Dana.*—*Tanai* similis. Pedes antici longissimi, tenuissimi, manu valde elongatâ. Antennæ superiores longæ, flagello confectæ. Abdomen 6-articulatum, stylis caudalibus articulatis.

LEPTOCHELIA MINUTA.—Corpus lineare. Pedes antici corpore valde longiores, manu fere corporis longitudine, digito polliceque tenuissimis, incurvatis, nudis, pollice prope apicem intus dentigero. Antennæ superiores corpore paulo longiores, basi elongato, 4-articulato, articulo secundo longiore, flagello 6–7-articulato, vix longiore quam articulus basalis secundus.

Hab. prope insulas "Viti" in mari Pacifico.

* *Arcturo*, antennis inferioribus flagello non confectis et segmento thoracis quarto prælongo, differt.

II. ISOPODA AMBULATORIA.*

Pedes seriei posticæ octo in his et totis Isopodis normalibus. Membra buccalia nullo modo suctoria. Abdominis appendices sexti sive operculiformes sive styliformes, nunquam ad natandum apti.

Familia 1. IDOTÆIDÆ.

Abdomen pauci-articulatum, articulo ultimo maximo, laminis duobus operculiformibus infra opertum, stylis caudalibus carens. Mandibulæ non palpigeræ.

Subfamilia 1. IDOTÆINÆ.

Pedes toti subsimiles, plerumque ambulatorii.

Genus IDOTÆA, *Fabricius*.—Segmenta thoracis subæqua. Antennæ externæ (vel inferiores) valde longiores, non geniculatæ, flagello multiarticulato confectæ. Abdominis opercula simplicissima, prope apicem articulati. Pedes quarti tertiique non valde inæqui.

1. IDOTÆA ARGENTEA.—Angusto-subelliptica anticè truncata vel obsoletè excavata, superficie æqua et lævis. Epimeræ latiusculæ. Abdomen 3-articulatum, segmentis duobus transversis, tertio oblongo, ad apicem paulo angustiore et truncato-rotundato, prope basin utrinque suturâ notato. Antennæ internæ dimidio basis externarum vix longiores. Antennæ externæ fere dimidii corporis longitudine, flagello 7-articulato, breviore quam basis, articulis 2 ultimis minutis.—Long. 5‴. Argentea et ad latera cærulescens.

Hab. in mare Pacifico, lat. aust. 77°, long. occid. 109°, super Porpitam.

2. IDOTÆA ANNULATA.—Angusto-subelliptica, fronte truncata, obsoletè arcuata, superficie annulatâ segmentis prominulis. Epimeræ latiusculæ. Abdomen 3-articulatum, segmentis duobus transversis, tertio oblongo, lateribus fere parallelis, ad apicem truncato cum angulis rotundatis, prope basin suturâ utrinque notato. Antennæ internæ dimidio basis externarum non longiores. Antennæ externæ fermè dimidii corporis longitudine, flagello breviore quam basis, 7-articulato, articulis 2 ultimis non breviores.—Long. 9‴. Brunnescens.

Hab. in mare Antarctica.

3. IDOTÆA BREVICAUDA.—Angustè ovato-elliptica, anticè posticèque truncata et medio minutè apiculata. Caput transversum, posticè segmento proximo amplexum. Abdomen 3-articulatum, segmentis duobus breviter transversis, tertio oblongo, posticè paulo angustiore, angulis rotundatis, prope basin suturâ notato. Antennæ internæ dimidio basis externarum non longiores. Antennæ externæ dimidium corporis longitudine vix superantes, articulo secundo brevi et ad apicem externum producto, flagello 9–10-articulato, paulo longiore quam basis.—Long. 6‴—9‴. Brunnescens.

Hab. in portu "Rio de Janeiro."

Genus EPELYS, *Dana*.—Antennæ breves subæquæ, externæ non geniculatæ, flagello non confectæ. Pedes subæqui, quarti tertiique non valde inæqui. Oculi minuti, remoti.

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* "Isopodes Marcheurs," Edwardsii, *Arcturo*, *Leachiâ*, *Tanai* et affinibus exclusis.

EPELYS ANNULATUS.—Angusto-subelliptica. Caput transversum, mediâ fronte apiculatâ, angulis rotundatis. Segmenta thoracis transversa, subæqua, prominentia. Abdomen 2-articulatum; segmento primo brevissimo, fere obsoleto, valde angustiore quam secundum; secundo scutellato, posticè triangulato, obtuso, lateribus mediis fere parallelis. Antennæ breves, latitudine capitis non longiores; internæ parce breviores, 4-articulatæ; externæ 5-articulatæ.—Long. $2\frac{1}{2}'''$.

Hab. ad oras prope Valparaiso, super corpus speciei Asterias.

Genus CLEANTIS, *Dana*.—Antennæ externæ valde longiores, non geniculatæ, 5-6-articulatæ, flagello non confectæ. Pedes quarti paris tertiis valde breviores, et parium quartuor ultimorum sensim longitudine increscentes. Abdominis opercula prope apicem articulata et ad articulationem laminam parvulam internam gerentia.

CLEANTIS LINEARIS.—Angusto-linearis, fronte truncata et parce excavata. Caput paulo transversum, posticè profundè arcuatum, segmento proximo amplexum. Oculi mediocres, reniformes, remoti. Segmenta thoracis paulo transversa. Abdomen 3-articulatum, segmentis duobus transversis, tertio lineari, angulis posticis truncatis, apice truncato aut obsoletè excavato, prope basin suturâ notato. Antennæ internæ parvulæ, dimidio externarum valde breviores; externæ crassiusculæ, articulo ultimo ovato, pubescente. Pedes tertii primis duplo longiores.

Hab. ad oras prope Rio Negro Patagoniæ.

Genus ERICHSONIA, *Dana*.—Antennæ externæ valde longiores, geniculatæ, 6-articulatæ, flagello nullo. Pedes subæqui, similes.

ERICHSONIA ANGULATA.—Elongato-elliptica. Caput et segmenta thoracis ad margines angulata, transversa. Frons excavata, duobis tuberculis supra armata. Segmenta thoracis quatuor antica tuberculum medianum gerentia. Oculi laterales. Abdomen uni-articulatum, oblongum, subscutellatum, margines sinuosum, posticè paulo latius, deinde triangulatum, obtusum. Antennæ internæ fere quadruplo breviores, 4-articulatæ; externæ clavatæ, dimidio corporis longiores, 5-6-articulatæ, articulis tribus ultimis subæquis, penultimo breviore, ultimo obtuso clavato breviter hirsuto. Pedis articulus basalis crassus et tuberculatus.

Hab. in portu Rio de Janeiro.

Subfamilia 2. CHÆTILINÆ.

Pedes sexti longissimi, setiformes et multiarticulati, non unguiculati; septimi fere similes.

Genus CHÆTILIA, *Dana*.—Antennæ primæ super secundas insitæ; superiores longiores; inferiores flagello multiarticulato confectæ. Pedes septimi sextis valde breviores, non unguiculati, parce multiarticulati. Abdominis opercula prope apicem articulata et ad articulationem lamellam parvulam internam gerentia.

CHÆTILIA OVATA.—Ovata, posticè acuminata. Thorax 7-articulatus, segmento septimo parvulo et partim celato, sexto utrinque acuto. Abdomen 4-articulatum, tribus segmentis transversis, quarto angusto-triangulato, ad apicem subacuto et ciliato. Antennæ lateraliter reflexæ; superiores fere dimidii corporis longitudine, 5-articulatæ, articulis duobus perbrevibus et crassis, tribus reliquis tenuibus, longis, ultimo extus subtiliter setuloso. Antennæ inferiores valde breviores, flagello fermè 10-articulato, articulis basis duobus ultimis anticè setulosis, posticè

pubescentibus. Pedes sexti corpore fere duplo longiores, minutè multiarticulati. Pedes septimi perbreves.—Long. 9‴.

Hab. in mari prope Rio Negro Patagoniæ.

New Haven, October, 1849.

2. *Gammaracea.*—The following recent genus is not included in the Synopsis of Gammaracea given in this volume, p. 135.

"EPHIPPHORA, *White*, (Phil. Mag., [3], i, 226, 1848.)—Head rather large; antennæ distant from each other, the upper pair with the basal joints very thick and corneous, inserted in a deep notch in front of head; two setæ at the end of each, the outer the thicker. Lower pair of antennæ with the basal joint somewhat elongated and furnished with hairs.

"Body much compressed, the lateral appendages on the first eight joints very large, and nearly concealing the legs; the appendage of the fourth joint much dilated behind at the end; eighth to eleventh joints slightly keeled on the back; appendages of the three last joints of the abdomen longish, with short spines on the edge behind.

"A genus allied to *Orchestia* and *Talitrus*.

"Sp. Ephipphora Kröyeri." * * * *

The description is hardly full enough to decide whether the genus is related most closely to the Orchestidæ or Gammaridæ. The large size of the basal joint of the upper antennæ, together with the large epimerals appear to show that it belongs with the Callianassinæ; and it may be identical with one of the genera in which the superior antennæ are appendiculate. J. D. DANA.

IV. ASTRONOMY.

1. *Elements of the planet Hygeia*, (Comptes Rendus, July 2, 1849.)—M. GASPARIS, of Naples, who discovered this planet April 12, 1849, has furnished the following elements of its orbit, derived from the observations of April 29, May 7 and 16, 1849.

Epoch, May 1, 1849.	
Mean Anomaly, . . .	326° 34′ 22″·44
Longitude of perihelion, . .	242 47 3 ·44
" " node, ...	285 32 29 ·72
Inclination, ...	3 46 51 ·27
Log. *a*, ...	0·5192506
Log. *e*, ...	9·2478343
Mean daily motion, . . .	590″·3784

2. *Second Comet of* 1849, (Comptes Rendus, May 14, 1849.)—The telescopic comet discovered April 11, 1849, by Geo. P. Bond of the Cambridge (Mass.) Observatory, (vii, 449) was detected the same night by M. Schweizer of Moscow. From the observations of April 14, 20 and 24, M. Sonntag has computed the following parabolic elements:

Perihelion passage, 1849, June .	8·20514 Berl. m. t.
Longitude of perihelion, . . .	267° 7′ 6″
" " asc. node, . . .	30 32 36
Inclination, ...	66 54 5
Perihelion distance, . . .	0·89391
Motion, ...	Direct.

These elements agree quite well with those of the second comet of 1748.

3. *Goujon's Comet*, (Comptes Rendus, May 14, 1849.)—A telescopic comet was discovered in the constellation Crater, by M. Goujon of Paris, April 15, 1849, who has published the following parabolic elements of its orbit:

Perihelion passage, 1849, May .	26·65161. Paris m. t.
Longitude of perihelion, .	235° 54′ 46″
" " asc. node, . .	202 33 28
Inclination, . . .	67 0 18
Perihelion distance, . . .	1·15816
Motion, ...	Direct.

4. *Shooting Stars of April* 20, 1849.—Messrs. GEORGE C. MURRAY, EDMOND R. SMITH and myself, made arrangements for watching the heavens, Thursday night, April 19, 1849, hoping that some recurrence of the meteoric shower of the morning of April 20, 1803, might be observed.

At midnight the sky was nearly overcast. After about three quarters of an hour we again went into the open air and found the sky almost clear. We did not begin our count until 1 A. M. (20th), although we saw a few meteors before this time.

Within the hour ending at 2 A. M., we observed *fifty-four* different shooting stars, as follows; viz., in N.W. 23; in S. 21; in N.E. 10. There was nothing remarkable in these as to brilliancy, nor was there any decided point of radiation. As usual there was a general motion towards the west. Some left trains, but on the whole the meteors were very much like those of common times. No aurora borealis was visible during the hour.

At 2 A. M. we left the field, having come to the conclusion that the number of meteors was not greatly beyond the average.

On the subsequent morning (21st), Mr. Smith watched from his window, for one hour ending at 2 A. M., and saw only four meteors.

E. C. H.

5. *Shooting Stars of August* 10, 1849.—At New Haven, the heavens were almost wholly overcast during the nights of the 9th, 10th and 11th of August, 1849, so that we were unable to observe the meteors expected at this period. The following testimony shows however quite satisfactorily that the meteors of August 10th, appeared the present year in their usual numbers. E. C. H.

(1.) *Canonsburg, Penn.*, (letter to the editors of this Journal, from Prof. S. R. WILLIAMS.)—On the evening of the 10th inst., I procured the aid of three competent assistants and made careful observations for meteors. The sky was cloudless, and until the moon arose (about 11 P. M.) a more suitable evening for our purpose could not be desired. Having obtained a favorable position, one observer faced the N.W., another N.E., a third the S.E., and the fourth the S.W., each counting only such meteors as appeared to originate in his quarter of the heavens. From 10 P. M. to 12½ A. M. of the 11th, we observed in all, *two hundred and sixty* meteors. They appeared with great regularity, about an equal number in each quarter of the heavens, and in each successive half-hour. About $\frac{8}{10}$ of all observed, moved towards the southwest, the remaining $\frac{1}{10}$ traversed the heavens in all directions.

There was no "central point" of emanation, though a majority perhaps, of the whole, appeared to originate in the directions of "Cassiopœia" and "Ursa Minor."

None were seen of startling brilliancy, though many were exceedingly beautiful. We should have continued our observations until day-dawn, had not the light of the moon interfered. On the night of the 11th also, the meteors were more than usually abundant, but by no means so numerous as on the evening preceding.

(2.) *Mineral Point, Wisc.*—A notice in the Tribune, signed "Sperry," and dated Mineral Point, August 9, 1849, states that *seventy-eight* shooting stars were seen there in "over an hour," probably before midnight, seventy-three of which appeared to start from a point near the *Swan*, a little S.E. of the zenith, and passed off in a southwesterly direction. The number of observers is not mentioned.

V. Miscellaneous Intelligence.

1. *On the Magnetic Relations of the Positive and Negative Optic Axes of Crystals;* by Professor Plücker *of Bonn, in a letter to* Dr. Faraday, (Phil. Mag., [3], xxxiv, 450.)—Allow me, sir, to communicate to you several new facts which, I hope, will spread some light over the action of the magnet upon the optic and magnecrystallic axes.

I. The first and general law I deduced from my last experiments is the following:—"There will be *either repulsion or attraction* of the optic axes by the poles of a magnet, according to the crystalline structure of the crystal. If the crystal is a *negative* one, there will be *repulsion;* if it is a *positive* one, there will be *attraction.*"

The crystals most fitted to give the evidence of this law are *diopside* (a positive crystal), *cyanite*, *topaz* (both negative), and other ones, crystallizing in a similar way. In these crystals the line (A) bisecting the acute angles made by the two optic axes, is neither perpendicular nor parallel to the axis (B) of the prism. Such a crystal, suspended horizontally like a prism of tourmaline, staurotide, or "red ferridcyanid of potassium," in my former experiments, will point neither axially nor equatorially, but will take always a fixed intermediate direction. This direction will continually change if the prism be turned round its own axis B. It may be proved by a simple geometrical construction, which shows that during one revolution of the prism round its axis (B), this axis, without passing out of two fixed limits C and D, will go through all intermediate positions. The directions C and D, where the crystal returns, make, *either* with the line joining the two poles, *or* with the line perpendicular to it, on both sides of these lines, angles equal to the angle included by A and B; the first being the case if the crystal is a *positive* one, the last if a *negative one.* Thence it follows, that if the crystal by any kind of horizontal suspension should point to the poles of a magnet, it is a *positive* one; if it should point equatorially, it is a *negative* one. This last reasoning conducted me at first to the law mentioned above.

The magnecrystallic axis, I think is optically speaking the line bisecting the (acute) angles made by the two optic axes; or in the case of one single axis, this axis itself. The crystals of bismuth and arsenic

are positive crystals; antimony, according to my experiments, is a negative one: all are uniaxal.

II. Cyanite is by far the most interesting crystal I have examined. If suspended horizontally, it points very well to the north, *by the magnetic power of the earth only*. It is a true compass-needle, and more than that, you may obtain its declination. If, for instance, you suspend it in such a way that the line A bisecting the two optic axes of the crystal be in the vertical plane passing through the axis B of the prism, the crystal will point exactly as a compass-needle does. By turning the crystal round the line B you may make it point exactly to the north of the earth, &c. The crystal does not point according to the magnetism of its substance, *but only in obedience to the magnetic action upon its optical axes*. This is in full accordance with the different law of diminution by distance of the pure magnetic and opto-magnetic action. If you approach to the north end of the suspended crystal the south pole of a permanent magnetic bar, strong enough to overpower the magnetism of the earth, the axis B of the prism will make with the axis of the bar (this bar having any direction whatever in the horizontal plane) an angle exactly *the same* it made before with the meridian plane, the crystal being directed either more towards the east or more towards the west.

The crystal showed, resembling in that also a magnetic needle, strong polarity; the same end being always directed to the north. I think this may be a *polarity of the opto-magnetic power*. Two questions too may easily be answered.—1st. Is the north pole indicated by the forms of crystallization? 2nd. Did the crystal obtain, when formed, its polarity by the magnetism of the earth? Between the poles of the strong electro-magnet the permanent polarity disappeared as long as the magnetism was excited.

I am obliged, by the new facts mentioned above, to take up my former memoir; I must reproduce it under quite a new shape. I will examine again the rock-crystal, which, being acted upon weakly by a magnet, induced me to deny in that memoir, what I ascertain now and what I thought most probable, as soon as I received the first notice of your recent researches. [That you will find in the memoir given to M. Poggendorff two or three months ago.] Perhaps the exceptional molecular condition of rock-crystal, as indicated by the passage of light through it, will produce a peculiar magnetic action.

I should be very much obliged to you, if you would give notice of the contents of my present letter to M. De la Rive, when he calls on you, as he intended to do. I showed him several of my experiments when he passed through Bonn the 12th of May. The following day I obtained the different results mentioned above.

Bonn, 20th of May, 1849.

2. *Some facts relative to the Spheroidal State of Bodies, Fire-Ordeal, Incombustible Man, &c.;* by P. H. Boutigny (d'Evreux), (Comptes Rendus, May, 1849; Phil. Mag., [3], xxxv, 60.)—In the year 241, Sapor or Chapour ordered the Magi to do all in their power to persuade them and bring them back to the faith of their ancestors. It was then that one of the pontiffs of the dominant religion, Adurabâd-Mabrasphand, offered to submit to the fiery ordeal. . . . "He proposed that eighteen

pounds of melted copper, issuing from the furnace, all hot, should be poured on his naked body, on condition that if he was not injured by it, the unbelievers should yield to so great a miracle. The trial was said to be attended with such success, that they were all converted." The historian adds, with an air of doubt, certainly allowable in such a matter, "We see that the religion of Zoroaster had also its miracles and its legends."*

Now this fiery ordeal, undergone with such success by Adurabâd-Mabrasphand, is in plain truth an experiment of primitive facility and simplicity, and which is anything but miraculous.

I stop here an instant, for I fancy that I see the smile of incredulity rise on the lips of some who do me the honor of listening to me;—that smile, so discouraging to one who is insincere, but which only heightens the ardor of him who intends to practice no deception, and who does all in his power not to deceive himself.

To such persons then I would offer this encouragement; the little that I have still to relate appears improbable, but it is true, and that is enough. Having said this, I continue.

In France, in England, in Italy, wherever I have had occasion to speak of bodies in the spheroidal state, I have met with persons who have put to me this question: May there not be some connection between these phenomena and that presented by men who run barefooted over liquid metal (?) still incandescent, or who plunge their hand into molten lead, &c.?† To all I have answered, Yes, I believe that there is an intimate relation between all these facts and the spheroidal state. And then, in my turn, I put this question: Have you witnessed the fact which you tell me? And the answer has invariably been in the negative.

I avow that all these *on-dits* and the marvelous legends which I had read in various works‡ on the fiery ordeal and incombustible men, admitted without reserve by some, obstinately denied by others, excited my curiosity greatly, and gave me a strong desire to verify all these phenomena, and to recall them to the recollection of contemporary observers; for, alas! all this is as old as the world; *nil sub sole novum.*

I wrote first to my friend Dr. Roché, who passes his life in the midst of the blast furnaces of the Eure, and who is the physician of a portion of the Cyclopean population who feed them. I requested of him precise particulars. All that he could ascertain was, that a man named La Forge, of from thirty-five to thirty-six years of age, very corpulent, walked step by step barefooted on the pigs after the casting: but he had not seen this. This was not enough to dispel my doubts.

I then applied to a foundry at Paris, where I was laughed at and shown the door. I retired, hanging down my ears, thinking over the difficulties of verifying a single fact, and such a simple one.

Subsequently I was fortunate enough to meet with M. Alph. Michel, who lives in the midst of the forges of Franche-Comté. M. Michel

* Dictionaire historique, critique et bibliographique, t. xxvii, p. 417.

† I have alluded to these facts in the work entitled, *Nouvelle branche de Physique*, or *Etudes sur les Corps à l'Etat sphéroïdal*, p. 36.

‡ *Des Erreurs et des Préjugés répandus dans les diverses classes de la Société*, t. xii, p. 183.

promised me, with the greatest kindness, to inquire into these facts, and to report upon them if desired.

The following is an extract from the letter which he did me the honor to write to me, dated the 26th of last March:—

"On my return home, I did not fail to obtain information from the workmen of the facts of the case (the immersion of the finger in the incandescent melted metal), and most of them laughed in my face, which did not deter me. Lastly, being one day at the forge of Magny, near Lure, I put the question again to a workman, who answered that nothing was more simple; and, to prove it, at the moment when the metal in a state of fusion issued from a Wilkinson, he passed his finger into the incandescent jet. A person employed in the establishment repeated the experiment with impunity: and I myself, emboldened by what I saw, did the same. . . . I may observe, that, in making this trial, none of us moistened his finger.

"I hasten, sir, to acquaint you with this fact, which seems to support your ideas on the globular state of liquids; for the fingers being naturally more or less humid, it is, I think, to this moisture passing to the spheroidal state, that we must ascribe their momentary incombustibility."

The following are the experiments which I have made:—

I divided or cut with my hand a jet of melted metal of five to six centimetres, which escaped by the tap, then I immediately plunged the other hand in a pot filled with incandescent metal, which was truly frightful to look at. I involuntarily shuddered. But both hands came out of the ordeal victorious. And now, if any thing astonishes me, it is that such experiments are not quite common.

I shall of course be asked, what precautions are necessary to preserve oneself from the disorganizing action of the incandescent matter? I answer, None;—only to have no fear, to make the experiment with confidence, to pass the hand rapidly, but not too rapidly, in the metal in full fusion.

Otherwise, if the experiment were performed with fear, or with too great rapidity, the repulsive force which exists in incandescent bodies might be overcome, and thus the contact with the skin be effected, which would undoubtedly remain in a state easy to understand.

To form a conception of the danger there would be in passing the hand too rapidly into the metal in fusion, it will suffice to recollect that the resistance is proportionate to the square of the velocity, and, in so compact a fluid as liquid iron, this resistance increases certainly in a higher ratio.

The experiment succeeds especially when the skin is humid; and the involuntary dread which one feels at facing these masses of fire, almost always puts the body into that state of moisture so necessary to success; but by taking some precautions, one becomes veritably invulnerable. The following is what has succeeded best with me: I rub my hands with soap, so as to give them a polished surface; then, at the moment of making the experiment, I dip my hand into a cold solution of sal-ammoniac saturated with sulphurous acid, or simply into water containing some sal-ammoniac, and, in default of that, into fresh water.

Regnault, who has occupied himself with this subject, says, "Those who make a trade of fire handling, and holding it in the mouth, some-

times employ an equal mixture of spirit of sulphur, of sal-ammoniac, of essence of rosemary, and onion-juice." All volatile substances, we see, which, in evaporating, render a certain portion of heat latent.

Let us now seek the rational explanation of these facts.

We have the formula $m\,c\,t$, which gives the quantity of heat contained in any body.

Let m be the mass expressed in kilogrammes,

c the specific heat of the body,

t its temperature.

But here the factor m must be abstracted, because there is no contact between the hand and the metal in fusion, and the experiment presents no difference, being made either with 10 kilogrammes of metal, or with 1000 kilogrammes. The sensation which is felt is the same in either case, and this is readily conceived, knowing the repulsive force of incandescent surfaces which is opposed to the contact of any body.

The finger or the hand is then isolated in the midst of the mass in fusion, and thus preserved from the disorganizing action of the incandescent matter. I repeat, that the mass must be abstracted.

There remain the two factors c, t. I will suppose, and it is a sufficient approximation, that the value of $c=0{\cdot}15$, and that of $t=1500$ degrees, the temperature of the metal in fusion; now the product of 1500 degrees $\times 0{\cdot}15=225$. Thus the epidermis of the experimenter would only be exposed to 225 degrees of heat. Undoubtedly this is a respectable quantity of caloric, but it is too high, as we shall see.

There is no contact between the hand and the metal; this, in my estimation, is a fact positively established. If there is no contact, the heating can only take place by radiation, and it is enormous, it must be acknowledged; but if the radiation is annulled by reflexion, and it is so, it is as if it did not exist, and, definitively, the operator is, so to say, placed in normal conditions.

I think that I have established, a long time ago, the fact that water in the spheroidal state has the property of reflecting radiating heat,* and that its temperature never attains that of its ebullition; whence it follows that the finger or the hand being humid, cannot rise to the temperature of 100° Centig., the experiment not continuing long enough to permit the humidity to evaporate entirely.

To recapitulate what I have stated on this point, I say,—in passing the hand into any metal in fusion, it becomes isolated; the humidity which covers it passes into the spheroidal state, reflects the radiating caloric, and does not become heated enough to boil. This is all.

I was right then in saying at the outset, this experiment, dangerous in appearance, is almost insignificant in reality.

I have often repeated it with lead, with bronze, &c., and always with the same success.†

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* Nouvelle branche de Physique, or Etudes sur les Corps à l'Etat sphéroïdal, pp. 24 *et seq.* and 132 *et seq.* See also our two letters to the Académie des Sciences, dated the 14th and 21st of July, 1845. In the places indicated will be found the explanation of this phenomenon.

† The experiments on the cast iron were made in the foundry of M. Davidson, at La Villette; and, on the bronze, in that of M. Nérat, Rue Pierre-Levée. I am happy to have an opportunity of publicly thanking these gentlemen for their kind assistance.

3. *Practical application of the Law pointed out by Dr. R. D. Thomson, of the proper Balance of the Food in Nutrition;* by Dr. C. REMIGIUS FRESENIUS, Professor of Chemistry at the Agricultural Institute of Weisbaden,* (Phil. Mag., [3], xxxv, 127, 1849.)—In reference to the question concerning the relation which must subsist between the nitrogenous and non-nitrogenous nutritive substances in the food of men and animals, it is but due to Dr. R. D. Thomson to acknowledge, that he considers this the most important circumstance in nutrition, and was the first to call attention to it.

This relation is obviously different in various classes of animals, and besides it must be different even in the same class of animals, according to their mode of life and to the amount of exercise they undergo.

An animal which is hard worked will require a different proportion from one which stands at rest in a stable; still more different must be the proportion when our object is to fatten the animal. I consider it to be one of the most important tasks of dietary and the feeding of cattle, to fix the requisite proportions suited to the various modes of life, for it may be understood that these limits cannot be overstepped on either side without injury.

Let us suppose, for instance, an animal requires under certain circumstances the proportion of one nitrogenous (nutritive) to five non-nitrogenous (calorifiant) constituents in its food; but if we give it food in which the proportion of one to ten prevails, there will be, in the process of nutrition, for every one part nitrogenous only five parts non-nitrogenous assimilated; the other half of the non-nitrogenous (calorifiant) aliment will be wasted.†

But it is not the pecuniary loss alone which arises through this, that deserves consideration; for it is clear that the animal will be burdened with the process of getting rid of the unassimilated half; for this object strength is required, which might otherwise have been spared.

If we give it food containing too large a proportion of nitrogenous aliment, in favorable circumstances it will consume the dearer instead of the cheaper non-nitrogenous aliment; but in unfavorable circumstances it will become diseased, by being compelled to act in opposition to nature.

Taking it for granted that the requisite proportions for different circumstances were ascertained, the choice of aliment could be regulated on the most rational basis.

[We speak here primarily only of the absolute strength of nourishment, without noticing the greater or less degree of digestibility possessed by equally nutritious substances, and the proportion of unassimilable constituents which they contain.]

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* Translated from the *Lehrbuch der Chemie für Landwirthe, Forstmänner und Cameralisten von* Dr. C. Remigius Fresenius (1847), page 480, by William Augustus Perston.

† The original passage is "So wird es beim Ernährungsprocesse auf je 1 Thl stickstoffhaltige eben doch nur 5 Thle stickstoffreie Besthandtheile verwenden, die andere Hälfte der stickstoffhaltigen Nahrungsmittel wird vergeudet." The true reading it is apprehended ought to be *stickstoffreie Nahrungsmittel*, and it has been thus rendered in the English version.—TRANS.

We observe, for instance, that cows on a meadow, feeding only upon grass, enjoy good health. Now let us endeavor to ascertain how we can produce the same proportion of non-nitrogenous and nitrogenous aliment with other descriptions of food.

The proportion which exists in grass or hay is 1 to 8·3, as in the following Table:—

	Relation of 1 part nitrogenous to non-nitrogenous.	Relation of 1 part nitrogenous to salts.	The following quantities contain 1 part of nitrogenous matter.			
			Nitrogenous, non-nitrogenous and salts.	Dried at 212°.	Dried in air.	Fresh substances.
	I.	II.	III.	IV.	V.	VI.
French beans	1·81	0·15	2·96	3·45	4·00	
Lentils	1·87	0·09	2·96	3·45	4·00	
Field beans	2·08	0·15	3·23	3·66	4·29	
Peas	2·14	0·11	3·25	3·66	4·28	
Wheat	2·42	0·11	3·53	4·21	4·85	
Oats	4·08	0·24	5·32	6·41	7·35	
Barley	4·25	0·27	5·52	6·53	7·57	
Rye	4·42	0·13	5·55	6·29	7·24	
Red turnips	5·08	0·42	6·50	6·45	....	35·3
Red clover	6·08	0·60	7·68	7·68	9·72	32·0
White turnips	6·39	0·55	7·94	7·91	....	65·1
Indian corn	6·55	0·10	7·65	8·13	9·34	
Mangel-wurzel	7·26	0·44	8·70	8·65	....	48·8
Carrots	7·84	0·55	9·39	9·39	....	67·6
Meadow-grass	8·30	0·73	10·03	10·73	12·47	32·8
Potatoes	9·	0·40	10·40	....	....	41·2
Oat-straw	12·5	2·04	15·54	40·00	55·55	
Wheat-straw	14·2	2·48	17·68	40·00	54·05	
Rice	14·8	0·10	15·90	16·61	18·41	
Rye-straw	24·4	1·93	27·33	53·48	65·79	
Barley-straw	29·3	3·08	33·38	52·35	58·82	
Cherries	41·	0·18	42·18	....	....	175·4
Pears	121·6	0·40	123·00	....	....	1250·

This Table, as given by Fresenius, is derived from German authorities, including several results obtained and published by Dr. Thomson in his Researches on Food, p. 167. See also Phil. Mag., vol. xxxii, p. 459. There is therefore some discrepancy when compared with English grain, the German grain being richer in nitrogen. See Dr. Thomson on the Composition of German and English Bread, Phil. Mag., vol. xxiii, p. 321.

Were we then to give them carrots, in which 1 part nitrogenous is contained for every 7·84 parts of non-nitrogenous constituents, the proportion would not be materially disturbed; but were we to give them potatoes (1 : 9), we disturb the proportion somewhat more. It is therefore expedient to feed them with a substance which is richer in nitrogen; this proper proportion may be obtained with exactness by mixing 1 nutritious equivalent of red clover with 3 nutritious equivalents of potatoes:—

$$1 \times 1 : 6 \quad = 1 : 6$$
$$1 \times 1 : 9{\cdot}00 = 3 : 27$$
$$\overline{\qquad\qquad}$$
$$4 : 33 \text{ or } 1 : 8{\cdot}25.$$

To produce this mixture, we feed them by giving them 9·7 lbs. of dried clover for every 123·6 lbs. of potatoes.

If we wished to give them the same proportion in white turnips and oat-straw, we must supply for every 2 nutritious equivalents of the former, 1 nutritious equivalent of the latter; for this mixture gives the proportion of 1 to 8·4; that is, they must be fed with 130 lbs. of fresh white turnips for every 55 55 lbs. of dried oat-straw.

A horse that works hard requires the proportion of 1 to 4. For this we give him oats which represent that proportion. But if we wished to give him the same proportion in field beans and hay, we must take for every 2 alimentary equivalents of the former 1 alimentary equivalent of hay, for such a mixture has the proportion of 1 to 4·1. We feed him therefore with 8·58 lbs. of dry field beans for every 12·47 lbs. of dry hay.

A man requires for a certain mode of life the proportion of 1 to 3. He wishes to eat beef and potatoes; he must, therefore, for every 2 alimentary equivalents of beef eat 1 alimentary equivalent of potatoes, for this mixture gives the proportion of 1 to 3·01; he must therefore use for every 2 lbs. of boiled beef (reckoned without water) 41 lbs. of potatoes (reckoned in the fresh state.)

If he wished to produce the proportion of 1 to 4 with carrots and raw bacon, he will attain it by mixing 5 alimentary equivalents of the former with 6 alimentary equivalents of the latter, which represent the proportion of 1 to 3·99. For this purpose he must eat 338 parts of fresh carrots for every 11 parts of raw bacon (reckoned free from water.)

Concerning the question, as to what is the proper quantity of aliment (possessing the due proportions) which is to be given under different circumstances, experience alone can determine it. For the computation, how the necessary quantity may be given in the diverse properly assorted alimentary mixtures, we would refer to the divisions III, IV, V, and VI, of the foregoing table.

If a cow requires in twenty-four hours 10 kilogrammes (22·05 lbs. avoirdupois) of air-dried hay, how many kilogrammes of the mixture given above of clover and potatoes would it require to replace it?

10 kilogrammes of air-dried clover contain in all 8·04 kilogrammes (17·728 lbs. avoirdupois) of nutritious matter, for

$$12{\cdot}47 : 10{\cdot}03 = 10 : x$$
$$x = 8{\cdot}04.$$

That mixture will consist of 9·7 kilogrammes (21·38 lbs. avoirdupois) of dry clover, which contain in all 7·68 kilogrammes (16·93 lbs.) of nutritious matter and 123·6 kilogrammes (272 5 lbs.) of potatoes, which contain in all 31·20 kilogrammes (68·79 lbs.) of nutritious matter.

133·3 kilogrammes (293·93 lbs.) of the mixture contain accordingly 38·88 kilogrammes (85·72 lbs.) of nutritious matter.

38·88 kilogrammes (85·72 lbs.) of the joint nutritious matters are equal to 133·3 kilogrammes (293·93 lbs.) of the mixture. How many are 8·04 equal to? $x = 27{\cdot}5$ (60·63 lbs.)

27·5 kilogrammes (60·63 lbs.) of the mixture in question are equivalent to 10 kilogrammes (22·05 lbs.) of hay in the proportion and quantity of nitrogenous and non-nitrogenous alimentary substances. In a precisely similar manner the kind and quantity of the salts must be attended to in practice.

Conclusions from the foregoing.—We have approximated much more closely to the object we had in view, viz., a completely rational system of nutrition, than it has hitherto been possible to do, and can answer the proposed questions with perfectly accurate average numbers; and we have now only duly to consider the influence which the unappropriated portions of food exert on the body (the getting rid of them involves a waste of strength;) and further, the greater or less degree of digestibility (*der leichteren oder schwereren, schnelleren oder langsameren Verdaulichkeit*) of each species of aliment, in order to do it with perfect precision.

But we can even now, from what has already been stated, educe safe and weighty conclusions, namely, the following:—

1. It is an impossibility to sustain either a man or a beast on food entirely devoid of nitrogen, however great in quantity it may be.

2. All that has been said in the older as well as in many of the newer books on husbandry, respecting the relative nutritive value of different kinds of forage, cannot, inasmuch as it was not arrived at by experience but deduced from theoretical views, possibly be correct, because these views do not accord with facts.

3. The discovery of the true relative value of aliment, and of the proportion in which it may be replaced, may be ascertained without much difficulty, so long as chemists and farmers work hand in hand for the exact solution of the above questions.

4. A completely rational system of nutrition, that is such an one as combines the greatest amount of strength with the least consumption of nourishment, will then be possible.

5. A loss of nutritious matter and of strength often takes place where it would be least expected, namely, by the consumption of all kinds of food (or forage) where the due proportion between nitrogenous and non-nitrogenous constituents does not exist, say by eating only fruit or potatoes.

6. It can with safety be decided by the above, under what circumstances substitutes for bread may be employed, and what is their respective value for each desired proportion.

Raw and cooked Articles of Food.—Many kinds of food cannot be eaten raw by man; others, although they may be eaten raw, agree much better with us when cooked.

Hence boiling, roasting, baking, &c. has a twofold effect; primarily, it converts indigestible food or that difficult of digestion into a digestible or more easily digestible condition. Thus, starch is converted into gelatinous starch, into dextrine or sugar; cartilaginous substances into glue; and chondrine, fibrine, into changed fibrine, &c. Secondly, it frequently confers upon them an agreeable taste.

But can the real nutritive value of food be augmented by cooking? Impossible! Still it may be of the greatest benefit in feeding cattle to cook their food. The advantage accrues in this way: that potatoes, turnips, &c. are more quickly and more easily digested when boiled than raw; and thus there is much less chance for any portion to be thrown off in an undigested state (unassimilated). Its warmth gives also a slight advantage to cooked food; it deprives the body of no heat; and the non-nitrogenous substances, which in the cold food would have

been required to afford heat, can be used for the production of fat. But whether cold or warm food is to be preferred in a practical point of view, cannot from all this be conclusively deduced. It is a question only to be answered by experience, for the result is entirely dependent on the nature and requirements of the animal.

4. *Meteorite of Arva*, (from the Oesterreische Blätt. für Lit. Kunst, &c., No. 169.)—At a meeting of the "Friends of Science," at Vienna, in 1847, A. Patera presented the results of the chemical analysis of the meteoric iron of Arva, made by him in the laboratory of A. Löwe. The description of the place where it had been found and of the iron itself, had already been published in the Vienna Zeitung of the 17th of April, 1844, and of March, 1845. The fragments of the pure iron employed in the analysis had a specific gravity of 7·814. The iron contained according to the qualitative examination, iron, nickel, a trace of cobalt, and an extremely small quantity of copper. The oxydized surface contained in addition, sulphur, carbon, silica, phosphorus and potassium, probably as unessential ingredients. The results of these analyses were:

Iron, . . .	89·42	93·13	94·12
Nickel, . .	8·61	5·94	5·43
Residuum containing silica and carbon,	1·41	. .	. .
	99·41	99·07	99·55

A. Löwe has had the kindness to furnish also his own results of two quantitative analyses. He found,

Iron, ...	90·471	91·361
Nickel, ...	7·321	7·323
Cobalt residuum,* carbon, silicia,	1·404	0·938
	99·196	99·622

At the meeting of the Society the following week, Franz von Hauer presented a series of communications from the Royal Counsellor of Mines, W. Haidinger, the first of which related to the chemical examination of the *Meteoric Iron of Arva*, communicated by A. Patera. A part of the results obtained was at that time reserved, and as M. Patera had since enjoyed the opportunity of visiting several interesting geological localities of Lower Hungary, he was now prepared to bring forward the portion omitted. Berzelius, it is known, had found in the meteoric iron of Bohumilitz, a peculiar metallic combination in clear steel-gray folia and grains, composed of iron, nickel and sulphur. Something altogether similar is found in the meteoric iron of Arva. Patera was enabled to collect a sufficient quantity of it to make three analyses, which agreed tolerably well with each other. The folia are flexible and strongly magnetic. Their hardness was 6·5; specific gravity 7·01–7·22.

Phosphorus, ...	7·26
Iron, ...	87·20
Nickel, ...	4·24
	98·70

* Traces of sulphur.

Some carbon was also obtained, but the amount could not be definitely ascertained.

As Berzelius had given no name to this substance, Haidinger, in concurrence with M. Patera, proposed for it the specific name of *Schreibersite.*

At a subsequent session (loc. cit. No. 231) Haidinger, referring to the name of Schreibersite, says he has since learned that the American mineralogist and chemist, Prof. Shepard, at the session of the Association of Science at New York, on the 2d of September, 1847, had given, in a very interesting paper on Meteorites, *this same name* to a mineral, also of meteoric origin, which occurs in small brown striated prisms in the meteoric stone of Bishopville, S. C., which fell in March, 1843, and was described by Prof. Shepard.

Undoubtedly this latter name has the priority, but yet priority is only a general rule which may in particular cases be deviated from.

Haidinger, therefore, would be pleased to continue the name of *Schreibersite* to the Arva Species, and would propose for Shepard's new species, the name of *Sh pardite*, which very properly will connect the discovery of the American species with the American naturalist, while in a native species it will express our high regard for the worthy naturalist of our own land.

5. *On the Preparation of a Glaze for Porcelain resembling Aventurine;* by A. Wæchter, (Liebig's Annalen, April, 1849; Chem. Gaz., Aug. 1, 1849, p. 305.)—According to Wöhler's examination, aventurine glass owes its golden iridescence to a crystalline separation of metallic copper from the mass colored brown by the peroxyd of iron.

In the aventurine glaze for porcelain a crystalline separation of green oxyd of chromium from the brown ferruginous mass of the glaze produces a similar effect. I prepare this glaze as follows:—

31 parts of fine lixiviated dry porcelain earth from Halle,
43 ... ... dry quartz sand,
14 ... ... gypsum,
12 ... ... fragments of porcelain,

are stirred up with 300 parts of water, and by repeated straining through a linen sieve uniformly suspended in it, and intimately mixed. To this paste I add, under constant agitation and one after the other, aqueous solutions of

19 parts bichromate of potash,
100 parts protosulphate of iron,
47 parts of acetate of lead,

and then add so much solution of ammonia that the iron is completely separated. The salts of potash and ammonia are removed by frequent decantation with spring water.

The baked porcelain vessels are dipped into the pasty mixture obtained as above described in the same manner as with other glazes, and then fired in the porcelain furnace. After this they appear covered with a brown glaze, which in reflected light appears to be filled with a countless number of little gold spangles.

A thin fragment of the glaze appears, under the microscope, by transmitted light, as a clear brownish glass, in which numerous transparent green six-sided prisms of oxyd of chromium, and some brownish

crystals, probably of oxyd of chromium and peroxyd of iron, are suspended. The oxyd of chromium therefore separates on the slow cooling of the glaze in the porcelain furnace, from the substance of the glaze—a silicate of potash, lime and alumina—saturated with the peroxyd of iron, and shines through the brownish mass with a golden color. When the aventurine glaze is mixed with an equal amount of colorless porcelain glaze, the glassy mass no longer has a brown color after the burning, but a light greenish gray, and the eliminated crystalline spangles likewise exhibit in reflected light their natural green color.

6. *On Chicory-Coffee, its History, Manufacture, Adulterations and means of detecting them;* by A. CHEVALIER, (Jour. de Pharm., July, 1849; Chem. Gaz., Aug. 1, 1849, p. 306.)—*History and Manufacture.* The manufacture of a factitious coffee from the roasted root of chicory appears to have originated in Holland, where it has been practised for more than a century. It remained secret until 1801, when it was introduced into France by M. Orban of Liege and M. Giraud of Horning a short distance from Valenciennes.

In a memoir upon coffee by M. Payssè, some details are given on the preparation of chicory-coffee in Holland. These were printed by Parmentier in the "Annales de Chimie" for 1806, and are as follows:

"The chicory for this purpose is collected in spring; the roots are conveyed to the manufactory, stripped of their leaves and washed to remove the soil.* They are cut into six parts, and then divided and dried. When dry, they are roasted in great cylinders like coffee. After the roasting, the chicory is reduced to a coarse powder.

"In Holland this chicory is then mixed in variable proportions with coffee; the resulting product is very bitter, which is considered by the common people to be a very salutary refreshment, which modifies the stimulant action of the coffee. Such a favorable idea has been formed of it, that of late this preparation has been employed alone, without any addition of coffee; and nevertheless it possesses no other virtue than that of coloring more or less readily the water in which it is boiled or infused, of communicating to the liquid the bitter taste of the extractive substances contained in chicory, and of being far less expensive than coffee."

M. Payssè adds, that "peas, lupins, beans, beet-root, carrot, &c., have been employed as substitutes for coffee."

The manufacture of chicory-coffee however remained for a long time stationary and of little importance; but for the last twenty years it has extended considerably, and has become an object of commerce of great importance. Till within the last few years it was carried on principally near Valenciennes; but since then manufactories have sprung up in several localities, especially at Arras, Cambray, Lille, Paris, Senlis in Normandy, Brittany and in England.†

The cultivation of chicory, to obtain the root for the purpose of converting it into coffee, has become a source of great prosperity for these districts. The plant requires a deep soil of good quality, and

* The roots are now no longer washed, as this operation is said to injure their value.

† For the last two years very large quantities of dry chicory have been exported from France into England.

well-prepared; the seed is sown in May, and the harvest takes place in October. Some time before collecting the roots, the leaves are mowed, and cows fed with them.* The roots are dug up with a spade, placed in heaps, and covered with straw to preserve them from frost.

The roots, thus collected, are cut at first longitudinally, and then transversely, in pieces from 5 to 10 centimetres in size; they are then carried into the drying chambers, which are heated with a kind of anthracite which produces no smoke. The roots are placed in layers of about 40 centimetres; they are frequently stirred to prevent them from burning and to facilitate the drying. Four such operations are made in about twenty-four hours. The roots dried by the above process are known by the name of *Cossétes*. They are kept in granaries; but in general sold almost immediately to the manufacturers, who roast them according to the demand. When the roasting is nearly complete, two per cent. of butter is added, and a couple of turns given to the roasting machine. This addition is made in order to impart lustre to the chicory, and to give it the appearance of roasted coffee. The substance is then emptied into iron vessels, and after cooling is crushed in vertical stone mills or between iron cylinders; it is then sifted, and during this operation a small quantity of reddish coloring substance (*rouge brun de Prusse*) is added to give it the color of coffee. The product is then weighed off, and sold in packets under a variety of names, but very rarely under its own; for instance, among others, *Mocha powder*, *Ladies' coffee*, *cream of Mocha*, *pectoral coffee*, *Chinese coffee*, *Tom Thumb coffee*, *Polka coffee*, *and colonial coffee*.

We have stated that it forms a very important object of commerce; in fact, 12,000,000 lbs. are consumed in France, and a large quantity is exported. On consulting the tables of the commerce in France, it will be seen that from 1827 to 1836 there was exported from France 458,971 kilogrammes of chicory coffee of the value of 321,282 francs; and since this period the amount has vastly increased.

Adulteration.—This substance is very frequently mixed with other ingredients, the means for detecting which consequently vary. We shall briefly notice them.

I. Brick-dust, ochre and earth may be detected by incineration and determining the amount of ash; 100 grms. of pure chicory coffee furnish from four to five per cent. of residue; an excess would indicate fraud.

II. Adulteration with coffee-grounds. This is carried on upon a great scale in Paris. It is easily detected. A sample of the suspected chicory is dried in a water-bath, and a pinch thrown upon the surface of a glass of water; the chicory almost immediately absorbs the water and sinks to the bottom of the vessel, whilst the coffee-grounds remain on the surface.

III. Adulteration with roasted bread, dirt and remains from vermicelli, &c. This adulteration is generally made with crusts of bread collected in the streets, crusts which are not always very clean. They are roasted or rather burnt in the oven, ground and mixed with the chicory-powder. This adulteration can be detected by iodine-water,

* It forms an excellent fodder; but when given alone, communicates a very disagreeable flavor to the milk of animals.

as the product resulting from the decoction of pure chicory does not strike a blue color.

IV. Adulteration with roasted acorns, which may be detected by iodine-water and by persulphate of iron, which in such a case strikes a black color.

V. Adulteration with roasted corn, haricots and peas may be detected by means of iodine-water.

There is no method as yet known of detecting the adulteration by roasted beet-root and carrot.

7. *On an unnoticed kind of abnormal vision;* by Prof. C. DEWEY.—There are two well known kinds of *abnormal* vision in eyes not diseased, the *far-sighted*, and the *near*-sighted. The former occurs in good eyes, as persons advance in life, beginning about the age of forty, and is remedied by *plane*, or better, by *convex* spectacles. The latter is found in youth or young persons, and finds its remedy in *concave* glasses. The *far-sighted* are unable to see near and small objects, and remove them at an inconvenient distance, while they see remoter objects perfectly well without glasses. The *near-sighted* are unable to see small objects unless they are brought inconveniently near, and have no distinct vision of remote objects.

There is a kind of abnormal vision, different from either of these, which is *not far-sighted* nor *near-sighted*, but in which near small objects, or larger distant objects, are not seen with distinctness. This imperfection occurs in children and young persons, and is remedied by *convex* spectacles which are suited to the eyes of persons from sixty-five to seventy years of age. The *younger* eyes require the *older* glasses, and with advancing years *less convex* glasses are required. At the age of forty-five or more, this kind of abnormal vision becomes much diminished.

As the young use the glasses of the farsighted, this kind may be called *neo-macropia*. It is evident that *convex glasses produce that change in the rays of light which fits such eyes to see distinctly small and large objects at varying distances*. This fact proves that there is no defect in the *adjusting power* of the eyes.

The cause then is to be sought in the *structure* of the eye. As this kind of eyes does not appear to be too much or too little convex, and as the image is not formed soon enough in the eye or is too far back, either or all of the three following may be the cause: 1, too little convexity of the crystalline lens, or 2, its position too near the retina, or 3, its too little density. The second is the probable cause. Spectacles sufficiently convex would bring the rays to a focus, let either or all of of the three causes operate, and with the usual adjusting power of the eye give distinct vision for near or remoter objects.

Though this kind of abnormal vision seems not to have attracted attention, for I have found but one *allusion* to it in consulting authors on optics, it is relatively common. In New England and New York, more than fifty instances of it have come to my knowledge in the five or six years past. A child of fifteen was able to see distinctly for the first time by the use of his grandfather's spectacles. A young man of eighteen required convex glasses of ten inch focus, while persons of seventy years use those of fourteen to eighteen inch focus. Children often make little progress in study, because they do not see

objects distinctly, though the defect is not suspected by them and is utterly unknown to parents and teachers. The knowledge of this subject will make spectacles a still greater benefit to our race.

8. *Analysis of the Waters of the Dead Sea;* by R. P. F. MARCHAND,* (Poggendorff's Ann. der Phys. u. Chimie, lxxvi, 462, 1849.)—A quantity of water from the Dead Sea was brought by Kunowski to Berlin, which he obtained at the north end not far from the mouth of the Jordan. Its specific gravity at 19° C., was 1·18415; at 13°, 1·1859. The analyses afforded—

Chlorid of calcium,	2·894
" magnesium,	10·543
" potassium,	1·398
" sodium,	6·578
" aluminium,	0·018
Bromid of magnesium,	0·251
Sulphate of lime,	0·088
Silica,	0·003
	21·729

9. *American Association for the Advancement of Science.*—We had intended to have given extracts of the proceedings of the recent Session at Cambridge in this number of the Journal. But as a pamphlet is now in course of publication, containing abstracts of the reports corrected throughout by the authors, we defer it for the present.

The proceedings were published at length in the *Boston Evening Traveller*, from whose office the pamphlet will soon be issued, and whence copies may be procured. We may add a word in behalf of this daily paper, published at Boston, as we have long appreciated its excellence. The various scientific and literary addresses and lectures of Boston and its vicinity are reported by it in full, and by stenographers that rarely miss a word that falls from the speaker's mouth. We are indebted to the editors in this way for the publication of Agassiz's lectures on Embryology, which we have been assured by those who know, are given with remarkable accuracy. The Lowell Lectures of Boston, by men of the hightest standing in their departments, may, through this paper, be enjoyed in distant portions of our country. We may hope therefore that the Boston Evening Traveller will widely travel, for it is one of the most important means in our country of disseminating scientific and literary information.—EDS.

10. *British Association.*—The British Association has just held its annual meeting at Birmingham, commencing with Sept. 12. We copy here the Report of the General Committee, as it will interest those who would promote the progress of the kindred associations in this country.

Report of the Council to the General Committee.—1. With reference to the subjects referred to the Council by the General Committee assembled at Swansea, the Council have to report—

1st. That they communicated the recommendation of the General Committee, for the continuance of the Magnetical and Meteorological Observatory at Toronto to the 31st of December, 1850, to Lord John

* Other analyses are cited in this Journal, xlviii, 12, together with an analysis by B. Silliman, Jr.

Russell through the President, the Marquis of Northampton. They have the pleasure of stating that the Observatory has been continued.

2nd. Pursuant to the request of the General Committee, the Council have taken into consideration the expediency of inserting in the Rules of the British Association, a paragraph to the effect that those gentlemen who have held the office of President of the Association should subsequently be *ex officio* members of the Council; and the Council now recommend that a paragraph to that effect should be inserted in the Rules of the Association.

3rd. The sum of 100*l.* placed by the General Committee at the disposal of the Council for the disbursements connected with the Kew Observatory has sufficed, under Mr. Ronalds's general superintendence, for the maintenance of the Observatory in the past year as a depository for the books and instruments belonging to the Association; and also for the preparation of the self-registering magnetical instruments, on Mr. Ronalds's plan, for the Toronto Colonial Observatory. Mr. Birt has completed the reduction and discussion of the series of electrical observations made at Kew; and Mr. Ronalds has drawn up a report describing the modifications and improvements which he has introduced in the self-registering apparatus during the last year. Both these reports will be read to Section A. preparatory to a consideration of any further recommendation which it may appear desirable to make for the continued maintenance of the Observatory. In connexion with this subject, the Council have great pleasure in announcing to the General Committee that Her Majesty's government, on the joint application of the Marquis of Northampton and Sir John Herschel, have granted to Mr. Ronalds a pecuniary recompense of 250*l.* for the invention of his method of constructing self-registering magnetical and meteorological apparatus. It will be recollected by many members of the General Committee that the subject of self-registering instruments was discussed at the meeting of the British Association at Cambridge, in 1845, upon the application for a grant of money from the funds of the Association to enable Mr. Ronalds to complete an apparatus for that purpose at Kew; and that a recommendation was made on that occasion by the Association to government—which recommendation was concurred in by the President and Council of the Royal Society—of the expediency of encouraging, by specific pecuniary rewards, the improvement of self-recording magnetical and meteorological apparatus.

As the grant to Mr. Ronalds has been made in consequence of that original recommendation and the favorable reply that was returned to it, and as the apparatus itself has been constructed and its successful operation shown at the Observatory of the Association, of which Mr. Ronalds is the Honorary Superintendent, the Council have deemed it proper to make this formal, and as they are sure acceptable, announcement of the favorable reception which has been given to the application on Mr. Ronalds's behalf; but they are glad, at the same time, to take the opportunity of expressing the satisfaction with which they have learned that the ingenious invention of Mr. Brooke, for similar purposes, have also received a pecuniary recompense from the government.

II. The Council regret that they are still unable to announce the publication either of Professor Edward Forbes's Researches on the Ægean

Sea, or of the Mountjoy Observations, for which purposes grants of public money have been sanctioned by Her Majesty's government at the recommendation of the British Association.

III. The Council have added the following names to the list of Corresponding Members of the British Association :—Prof. Plücker, of Bonn; Dr. Siljeström, of Stockholm; Prof. H. D. Rogers, of Philadelphia.

IV. Prof. Dove, of Berlin, Corresponding Member of the British Association, having offered to supply the Association with as many copies as might be desired of his Maps of the monthly Isothermal Lines of the Globe, founded upon the Temperature Tables printed in the volume of the Reports of the British Association for 1848, which maps have been partly engraved and partly lithographed at the expense of the Royal Academy of Sciences at Berlin, the Council directed that Prof. Dove should be requested to supply the Association with 500 copies, on the understanding that the Association should pay for the paper and for taking off the impressions; and that the copies thus furnished should be sold, under the direction of the officers, to members of the Association at cost price, with the translation of a report from Prof. Dove explanatory of the Maps and of a more obvious conclusion deduced from them. The Maps have been completed, but from accidental circumstances the packet containing the first 200 copies prepared for the Association, has not yet been despatched from Berlin, and cannot be expected to reach England until after the meeting at Birmingham is over; but copies of the Maps and Report will be forwarded immediately after they arrive, to members who may be desirous of purchasing them, and who give their names for that purpose in the Reception Room. The cost of each copy will be 5*s.* for the three Maps.

V. The Council has directed that the following additions should be made to the Regulations, according to which the volumes of the Reports are distributed to the Members :—

1. That members who have formerly paid 5*l.* as a life composition, and shall at any future time pay an additional sum of 5*l.*, shall be entitled to receive (gratis) the volumes of the Transactions which shall be published after the date of such additional payments.

2. That Members shall have the opportunity of purchasing any of the already published volumes of the Association, of which more than one hundred copies remain, at half the price at which the volumes were issued to the public.

VI. The Council have great pleasure in submitting to the General Committee the following list of invitations from which the General Committee will have to select the place of meeting of the Association in 1850.

a. Invitations received at Swansea by the General Committee, and which stood over after the selection of Birmingham, 1849 :—

From Ipswich, for 1849,—signed by the high sheriff, the Bishop of Norwich and eighty gentlemen of the eastern counties.

From Bath, for 1850,—signed by the Mayor.

From Derby, for 1850.

b. Invitations received since the Swansea Meeting and communicated to the Council :—

From Edinburgh, for 1850,—from the Lord Provost, Magistrates and Council—from the Senatus Academicus, and from the Royal Society of Edinburgh.

From Belfast for 1850 or 1851—from the Town Council—the Royal Academical Institution—the Natural History and Philosophical Society, and from the Harbor Commissioners.

From Manchester, for 1852,—from the Royal Institution—the Geological Society—the Natural History Society—the School of Design, and the Mechanics Institution.

From Hull, for an early meeting—from the Literary and Philosophical Institution.

VII. The Council have received and submit to the General Committee the following letter from Lieut. Col. Sabine :—

"*To the President and Council of the British Association.*

"GENTLEMEN,—I beg leave to acquaint you that it is my intention, at the meeting of the Association at Birmingham, to resign into the hands of the General Committee the office of General Secretary, with which I have been honored, by annual re-election, for ten successive years."

[We omit the continuation of Col. Edward Sabine's communication.]

The Treasurer's Report is as follows :—

The General Treasurer's account, from 8th of August, 1848 (*at Swansea*), *to the 12th of September*, 1849 (*at Birmingham*).

RECEIPTS.

	£.	s.	d.
Life Compositions at Swansea,	30	0	0
Annual subscriptions, " and since,	150	0	0
Associates' "	376	0	0
Ladies' Tickets, "	197	0	0
Book compositions,	6	0	0
Dividends on stock,	116	10	1
Sale of stock (1,000*l.* three per cent. consols,)	917	9	2
From sale of publications :—			
Of the 2d volume, £0 7 2			
" 3d " 1 8 0			
" 4th " 1 4 4			
" 5th " 0 15 2			
" 6th " 2 2 11			
" 7th " 2 6 0			
" 8th " 3 0 4			
" 9th " 1 18 0			
" 10th " 3 7 6			
" 11th " 1 19 11			
" 12th " 3 0 9			
" 13th " 5 12 0			
" 14th " 5 4 0			
" 15th " 15 10 0			
" 16th " 80 0 0			
" 17th " 0 6 0			
British Association Catalogue of Stars, 28 1 10			
Lalande's " 9 8 2			
Lacaille's " 1 16 5			
Lithograph signatures, 0 15 0			
	168	3	6
	£1,961	2	9

			£.	s.	d.
Balance brought on from last account,			9	7	10
PAYMENTS.					
For sundry printing, advertising, expenses of the meeting at Swansea, and sundry disbursements made by the General and Local Treasurers,			287	1	9
Printing, &c., the 16th vol. (17th Report),			644	6	8
Salaries—Assistant General Secretary and Accountant, 18 months,			500	0	0
Paid by order of Committee on account of grants for scientific purposes:—					
Electrical observations at Kew,	£50 0 0				
Vitality of seeds,	5 8 1				
Acid on the growth of plants,	5 0 0				
Registration of periodical phenomena,	10 0 0				
Bills on account of anemometrical observations,	13 9 0				
			83	17	1
Maintaining the establishment at Kew Observatory:—					
Balance of grant of 1847,	20 15 7				
Part of grant of 1848,	55 6 10				
			76	2	5
Balance in the bankers' hands,	335 13 4				
" in General and Local Treasurers' hands,	24 13 8				
			360	7	0
			£1,961	2	9

Edinburgh has been accepted as the place for the next annual meeting of the Association, and Sir David Brewster has been chosen President for the session.

11. *Total Quantity of Lead Ore raised and Lead smelted in the United Kingdom in* 1848, (Official Report by R. Hunt, keeper of mining records, Mining Journal, Aug. 25, 1849.)

England,	Lead ore.	Lead.	Wales,	Lead ore.	Lead.
Cornwall,	10,494 tons	6,614	Cardiganshire,	4,902 tons	3,180
Devonshire,	1,334	844	Carnarvonshire,	21	14
Cumberland,	8,272	5,684	Carmarthenshire,	307	204
Durham and Northumberland,	18,815	14,658	Denbigshire,	....	....
			Flintshire,	10,056	7,069
Westmoreland,	519	388	Montgomeryshire,	927	601
Derbyshire,	5,185	3,370	Merionethshire,	92	54
Shropshire,	4,130	2,762			
Somersetshire,	41	29	Total,	16,305	11,122
Yorkshire,	6,848	4,793			
			Ireland,	1,912	1,188
Total,	55,638	39,142	Scotland,	2,588	1,736
			Isle of Man,	2,521	1,665

Making a total of 78,964 tons of lead ore, and 54,853 tons of lead.

Imported, 1,298 tons lead ore; pig and sheet lead, 3,788 tons; retained for home consumption, 2,157 tons.—*Exported*, 135 tons lead ore; pig and rolled lead 4,977 tons; shot 1,151; litharge, red and white lead 2,292; foreign lead in sheet and pig, 3,747 tons.

12. *California Gold.*—The gold of California has been analyzed by Dr. Hofman and found to consist of gold 89·61, silver 10·05=99·66, the loss being some copper and iron, which was not determined.

13. *Coal in Egypt.*—The discovery of mineral coal in Egypt has recently been made by a French civil engineer. It occurs in the vicinity of the Nile, towards Upper Egypt. Excavations are to be made on a large scale.

14. *Astronomical Journal.*—The following Prospectus of a new Astronomical Journal to be established in this country has recently been issued; and we would commend the undertaking to all interested in the progress of science. Astronomy has gathered the brightest laurels for the nations of Europe; and the success which has already attended American effort may well incite us onward. The Journal will necessarily be a dry one for the reader, if truly valuable; yet from its importance it demands the widest encouragement and support. The Prospectus was drawn up by a committee of the American Association for the Advancement of Science, held at Cambridge August 21, 1849, to whom the subject was submitted by Prof. J. S. Hubbard.

"An Astronomical Journal, for the publication of original researches, has long been needed in the United States, and the want is growing more urgent every day. American Astronomy demands an organ, in which important investigations and observations may be published without delay, and which may serve especially as a magazine for astronomical researches made in this country, as a vehicle of information concerning the labors of individuals, and as an exponent of the general progress of science. An admirable model for such a publication is to be found in the celebrated *Astronomische Nachrichten* of Prof. Schumacher.

Our astronomers and mathematicians have been hitherto compelled to resort to the columns of foreign journals, or to those at home which are expressly designed for other purposes. The extremely valuable journal of Prof. Silliman has lent them important assistance, notwithstanding that this is devoted to general science, and the diffusion of scientific information.

The aim of the journal now proposed is the advancement, rather than the diffusion, of astronomical learning; and it is hoped that the lovers of astronomy throughout the country will join in sustaining it. A publication of this kind—not claiming to possess special interest for the community in general—appeals for support to those lovers of truth who desire to contribute their share to whatever may develop and foster science in America; and it cannot succeed without their hearty coöperation.

The plan of the proposed journal contemplates not only researches in every department of Physical, Theoretical, and Practical Astronomy, but also investigations on all subjects directly connected with these, such as Pure Mathematics, Geodesy, the theory of instruments, &c.;—to the exclusion, however, of popular articles and general speculations.

It is thought best that the successive numbers of the Journal should appear, not at stated periods, but irregularly, at such intervals as the

amount of matter at hand, or the importance of information to be communicated, may require. It is also contemplated to issue circulars in cases where the prompt dissemination of intelligence may be important.

The Editor expects no remuneration, and it is estimated that one hundred and eighty subscribers will defray the necessary expenses of the work. The committee hope that the several universities and colleges of the Union will offer their assistance.

A volume will consist of twenty-four sheets (eight pages) in quarto, and the price is fixed at $5.00 the volume, payable in advance. All subscription and communications may be addressed to the Editor, B. A. Gould, Jr., Cambridge,—or to the publishers, Messrs. James Munroe & Co., Cambridge and Boston.

B. A. Gould, Jr.,	Sears C. Walker,	M. F. Maury,
J. S. Hubbard,	Joseph Henry,	C. H. Davis,
John H. C. Coffin,	A. D. Bache,	Benj. Peirce."

October 1, 1849.

15. *Geological Surveys of the United States.*—At the recent meeting of the American Association for the Advancement of Science, resolutions were offered, strongly urging the completion of geological surveys of the several states of the Union which still remain unfinished. There are several cases of this kind, and the interests of the State, the Country, and of Knowledge, strongly demand that the work be carried forward. Large portions of our territory, rich it may be in wealth of minerals, building material, fertile soil, and various productions valuable in the arts, remain unexplored, and where explorations have been made, there have been delays in the publication of Reports, which are not creditable to the Legislatures that have this matter in control, nor just to those who have been laboring in the surveys.

OBITUARY.

16. Ludwig Frederick Wilhelm August Seebeck died at Dresden on the night of the 18th and 19th of March last. He was a prominent member of the Berlin Academy, the author of works on Optics and Acoustics, and Professor of Natural Philosophy at Leipsic. He was born at Jena, the 27th of December, 1805.

17. Johann Wolfgang Döbereiner, the distinguished chemist, died at Jena on the 24th of March. He was born on the 13th of December, 1780, at Cur in Bayreuth.

18. Wilhelm Ferdinand Erichson, died on the 18th of November, 1848. For seven years he had conducted Wiegman's Archiv, a zoological journal of the highest rank in science. He was especially distinguished in the department of Entomology, and enjoyed the highest reputation for thorough and extensive knowledge.

The *Archiv* will be issued hereafter under the editorship of Dr. Troschel of Berlin.

VI. Bibliography.

1. *Iconographic Encyclopædia of Science, Literature and Art, systematically arranged;* by G. Heck. With 500 steel engravings, by the most distinguished artists of Germany: the text translated and edited by Spencer F. Baird, A.M., M.D., Professor of Natural Sciences in Dickinson College, Carlisle, Pa. Rudolph Garrigue, N. Y., 2 Barclay street. —This elaborate work is an illustrated Encyclopædia of Science and the Arts. The plates are in 4to, and are issued in portfolios of twenty plates, along with about 80 pages of text. The engraving is exquisite in style, and each plate is crowded with figures and equivalent to a volume of learning. The first of this series contains nearly 100 distinct figures, and the second over 150, illustrative of various problems in plain and solid geometry. Another is occupied with about 65 figures relating to problems in surveying, measuring heights, &c., to leveling, topographical drawing, projection, conic sections, &c., projection of shadows, perspective. The next includes drawings of various mathematical instruments, elaborately detailed, as the following: Hair compasses, proportional compasses, beam compasses, triangular compasses, Farey's elliptograph, pantograph, eidograph, parallel ruler and spring compasses, protractor, measuring staff and chain with arrows and pickets, plane table, Thayer's plane table, level, diopter ruler, astrolabe, compass, repeating circle, graphometer, sextant, leveling instruments. Another plate illustrates in beautiful style the change of the seasons upon the earth, the forms and appearances of comets, different nebulas, Saturn and his belt, &c.; and this is but one of ten plates devoted to astronomy, among which No. 11 is a very elegant map of the moon's surface, with enlarged drawings, around the margin, of many of the great craters. The same completeness and delicacy of delineation extends to all departments.

The text contains a brief statement of the principles of the sciences under consideration, enunciations of problems usually without full demonstrations, descriptions of instruments, and explanations of their modes of use, &c. &c. The translation from the German is by Prof. Baird, of Carlisle, Pennsylvania, a man of accurate learning, and extensive knowledge of science. We take the following from the Prospectus, issued with the first number, the only part yet out.

The Iconographic Encyclopædia will embrace (in a series of 500 quarto steel engravings, and upwards of 2000 pages of letter-press in large 8vo,) all the branches of human knowledge which can be illustrated by pictorial representations, viz:—

I. Mathematics. II. Natural and Medical Sciences. III. Geography. IV. Ethnology. V. Military Sciences. VI. Naval Sciences. VII. Architecture. VIII. Mythology, &c. IX. The Fine Arts. X. Technology, with all their respective subdivisions.

The work will be published in 25 monthly portfolios, each containing 20 engravings and eighty pages of letter-press. Price one dollar each part. Subscriptions taken for the whole work only.

As the different departments of science, from their varying natures, will demand more or less detailed explanations in letter-press, eighty

pages of text will not always be sufficient to explain thoroughly the representations of twenty engravings, whilst in other instances less than that space will be required. Thus the explanatory text belonging to 20 plates, but exceeding eighty pages, will be furnished with the following 20 plates, so that at the end of the work text and plates will run together, and form a complete manual of the enumerated sciences, with a full collection of pictorial illustrations, executed on steel with the greatest care and accuracy.

It having been deemed of great importance to unite the greatest possible cheapness with beauty and intrinsic value, the great expense of re-engraving the plates has been avoided, and a contract made to secure good impressions, taken under the immediate supervision of Mr. Heck, the original framer of the work, from the highly finished German plates; and the specimens now before the public will prove that they could not have been produced in this country at less than double the price for which they are now offered.

A small proportion of the 500 engravings constituting the whole work (about 50, representing astronomy and geography) have inscriptions (chiefly astronomical and geographical names) in the German language, which could not have been altered except at a very great expense. This circumstance will, however, in no way interfere with the perfect clearness of the matter represented, as the accompanying English text, referring strictly to the designs of the plates, gives every explanation required. Besides, a full glossary of all foreign words occurring on the plates will be issued at the end of the work for the benefit of those who wish to make themselves acquainted with the several names and expressions.

Indexes and tables of contents will be issued with the last part of the work, adapting it to practical use, and facilitating reference to any of the branches of science it embraces.

After the description of the work given, it is needless to add words of commendation. It will be found very widely useful, and we doubt not will command an extensive circulation.

2. *Genera Floræ Americæ Boreali-orientalis illustrata:* The Genera of the Plants of the United States; illustrated by figures and analyses from nature, by Isaac Sprague, Mem. Bost. Nat. Hist. Soc.; superintended and with descriptions, &c., by Asa Gray, M.D., Prof. Harvard Univ., &c. Vol. II, plates 101 to 186. 8vo, pp. 230. New York, 1849. G. P. Putnam.—We take pleasure in announcing the second volume of this truly national work. The authors have undertaken to illustrate all the genera of the plants of the United States with detailed figures and descriptions, and the work should meet not only with approbation, but with substantial proofs of favor on every side. This volume includes the orders from Caryophyllaceæ and Malvaceæ, to Polygalaceæ and Krameriaceæ. The plates are elegant specimens of the art of engraving, and may delight the eye that cannot appreciate all the minute scientific detail so carefully wrought out by dissections and careful scrutiny; the number included in the volume is 87.

In the descriptive portion of the work, the generic character of each genus is briefly given in Latin, and is followed by a full synonymy. Then follows a detailed description in English of the parts of the

plants, their characteristics, habits, geographical distribution, properties, together with critical remarks, and the etymology of the name. Under each family, there is a tabular view of the genera with their distinctive characters. The work is of great importance to the student of Botany. A glance at a figure may resolve the most stubborn doubts left on the mind by the mere description, besides giving an insight into the structure of a plant and its fructification which none but a master could unfold.

3. *The Sea Side Book, being an Introduction to the Natural History of the British Coast;* by Dr. W. H. HARVEY. 1 vol. 12mo. With numerous wood cuts.—If we had not been upon the sea shore when we first perused this delightful little volume, we could scarcely have resisted the temptation to repair thither at once, so vividly are depicted in it the attractions which the productions of the sea present to the naturalist. Although written especially for the British Islands, it contains much that is applicable to our own shores. As the first edition is already exhausted, it is to be hoped that a second may soon appear to win, as it cannot fail to do, new recruits to the ranks of science.

J. W. B.

4. *Phycologia Britannica: or, History of the British Sea Weeds, including Colored Figures of each Species, with Growth, Fructification, &c.;* by Dr. W. H. HARVEY, M.R.I.A., Keeper of the Herbarium of the University of Dublin. Price per No. 2s. 6d. col.—Upwards of forty numbers of this very beautiful work have already appeared, and they justify the high expectations which were excited on its first announcement. Each number contains a number of admirably executed colored lithograph plates of British Algæ, accompanied by descriptions. When completed it will include all the British Marine Algæ now known, and will be indispensable to all who wish to study the Algæ of either the British or North American shores.

It is to be hoped the distinguished author, who is now in our country, may be induced to illustrate our American species in a similar style. They could not be in better hands. J. W. B.

5. *Nereis Australis: or, Illustrations of the Sea Weeds of the Southern Ocean, including figures of Growth and Fructification, &c.;* by Dr. W. H. HARVEY, M.R.I.A., &c. In four parts, (two of which are published.)—These volumes rival in beauty the Phycologia Britannica. They contain many new genera and species and should be in the hands of every student of general Phycology. The beauty of the plates would make the work an ornament for any library. J. W. B.

6. *A Manual of the British Marine Algæ;* by Dr. W. H. HARVEY, M.R.I.A., &c. Second edition. With plates. 1 volume.—We have as yet only seen the plates to this volume which is about to issue from the press. We learn that it is completely re-written and embraces all the British *marine* Algæ, a great number of which are inhabitants of our own shores. The plates illustrate the structure of one or more species of each genus, and will be a great aid to beginners. J. W. B.

7. *Species, Genera et Ordines Algarum, seu Descriptiones Succinctæ Specierum Generum et Ordinum quibus Algarum Regnum constituitur;* auctore JACOBO GEORGIO AGARDH. Volumen Primum. Algas Fucoideas complectens. 1 vol. 8vo. pp. 363.—This volume is sufficiently

recommended by the name of Agardh, which is as much identified with Algology as that of Linnaeus is with Botany. Since the elder Agardh published his Systema Algarum, there have been such vast additions to the knowledge of this difficult tribe of plants that an attempt to arrange the chaotic materials by such an experienced hand as that of the younger Agardh cannot but be welcome. This volume contains a full description of all the Fucoideæ (Melanospermeæ of Harvey) and appears to be written with great care and judicious discrimination. The second and third volumes which are to contain the Zoospermeæ and Florideæ will be eagerly looked for. J. W. B.

8. *Species Algarum;* auctore FRIDERICO TRAUG. KÜTZING, Prof. NORDHUSANO. 1 vol. 8vo. pp. 922.—This is a handsomely printed volume embracing the whole range of Algæ and even including those obscure organisms, the *Diatomeæ* and *Desmidieæ*, which seem "to hover between two worlds," the vegetable and the animal. About 600 genera are described, of which, as well as of the species, many are new. Much valuable information is contained in this volume as well as in the Phycologia Generalis, and "die kieselschaligen Bacillarien oder die Diatomen" of the same author. J. W. B.

9. *Tabulæ Phycologicæ, oder Abbildungen der Tange, herausgegeben* von F. T. KÜTZING. I. bis V. Lieferung, Gr. 8. Preis einer Lieferung mit 10 schwarzen Tafeln 1 Thlr., colorirt 2 Thlr.—We have not seen any portion of this work, but we learn that as the Diatomeæ have been figured in the author's work on "die kieselschaligen Bacillarien," and the Desmidieæ in Ralf's unrivaled volume, "the British Desmideæ," they will be omitted in this work, which will give representations of the remaining portions of the Algæ. Executed with the skill displayed in the plates to the author's Phycologia Generalis, the work cannot but be a most valuable addition to science.

J. W. B.

10. *Geology of the United States Exploring Expedition under* C. WILKES, U. S. N.; by JAMES D. DANA, Geologist of the Expedition, 750 pp. 4to, with 4 maps, numerous wood-cuts, and an atlas of 21 folio plates. This work which has just appeared from the press, treats of the following subjects.

I. General remarks on the Pacific Ocean—topography and trends of islands—geological structure. pp. 9–26.

II. On Coral Formations—features, structure, origin, distribution and geological deductions. pp. 29–154.

III. On the Hawaiian (Sandwich) Islands—including deductions on volcanic action. pp. 155–284.

IV. V. VI. Society Islands,—Samoan or Navigator Islands,—Viti or Feejee Islands. pp. 285–352.

VII. Pacific Ocean,—1, General view of volcanic action; 2. Origin of some peculiarities in the lithological character of the Islands; 3. Origin of Valleys; 4. Changes of level as indicated by the distribution of Coral reefs, and other evidences; 5. On the general arrangement of land in the Pacific; 6. Origin of the general features of the Pacific and of the Globe. pp. 353–436.

VIII. On New Zealand, particularly the vicinity of the Bay of Islands. pp. 437–538.

IX. On New South Wales, its sandstones, coal formation, fossils, basaltic and allied rocks, degradation and denudation, evidences of change of level. pp. 449–538.

X. XI. XII. On the Philippine and Sooloo Islands—Deception Island —Madeira. pp. 539–556.

XIII. XIV. On a part of Chili.—On the vicinity of Lima, Peru, and the islands of San Lorenzo. pp. 557–600.

XV. On the vicinity of Nassau Bay, Tierra del Fuego.

XVI. On the vicinity of Rio Negro.

XVII. On Oregon and Northern California.

APPENDIX.—1. Fossils of New South Wales; 2. Fossils of Tierra del Fuego and Peru; 3. Fossils (tertiary) of Oregon.

The Atlas is occupied with the drawings of Fossils, 14 folio plates being devoted to New South Wales, 1 to Tierra del Fuego and Peru, and the remaining 6 to Oregon.

There are but 85 copies of this work on sale, and these are in the hands of Mr. G. P. Putnam, publisher, &c., New York City. Only 100 were printed besides the 100 ordered by government.

11. *Report on Zoophytes, of the Exploring Expedition under* C. WILKES, U. S. N.; by JAMES D. DANA.—The atlas of this work has just appeared. The text, a volume of 740 pages in 4to, was announced by us in 1846. The atlas consists of 61 plates in large folio, containing representations of the corals described in the text, very many of which are colored, and exhibit the coral animals drawn from the living Zoophyte. The first 5 plates are devoted to Actiniæ, the elegant figures of which are by Mr. J. Drayton, Artist of the Expedition. The remaining 56 plates with one exception, are from drawings by the author of the work. The volume of plates owes much, artistically, to the superintendence and taste of Mr. Drayton. Less than 100 copies of the work on Zoophytes, have been on sale by Lea & Blanchard, of Philadelphia.

12. *Principles of the Mechanics of Machinery and Engineering;* by JULIUS WEISBACH, Professor of Mechanics and applied Mathematics in the Royal Mining Academy of Freiberg. First American edition, edited by WALTER R. JOHNSON, A.M., Civ. and Min. Eng., Washington, D.C. 2 vols. Vol. II, Applied Mechanics, 364 pp. 8vo. Lea & Blanchard.—This volume, like volume I, is elegantly illustrated with numerous wood-cuts. It treats in a masterly manner of the equilibrium and pressure of fluids, theory of arches; of framings of wood and iron; strength of materials; rigidity of cordage; measure of moving powers and their effects; of animal power and its recipient machines; of collecting and leading water, and on water wheels, vertical and horizontal; on windmills.

13. *The Progress of the Development of the Law of Storms and of the Variable Winds, with the Practical Application of the subject to Navigation;* illustrated by charts and wood-cuts. By Lieut. Colonel WILLIAM REID, C.B., F.R.S., 424 pp. 8vo. *London*, 1849.—The labors of Lieut Col. Reid are adding largely to the amount of information on the nature of storms, and confirming the laws laid down by Mr. Wm. C. Redfield. Another volume from his hands of over 400 pages exhibits the increasing interest which the investigations are receiving, as well as the untiring spirit of investigation and careful research of

the author. This work reviews the subject of storms, explains principles, gives practical directions for navigators, and details many examples of storms in different seas, showing their conformity to the system exposed, and pointing out the lessons which they teach. If with the aid of this work and Piddington's Hornbook of Storms (which is perhaps more convenient and simple), and also the writings of Mr. Redfield, navigators do not learn the character of the winds and gales they have to encounter, they deserve certainly no better fate than the hurricane has in store for careless or willful ignorance.

14. *Outlines of Astronomy;* by Sir JOHN F. W. HERSCHEL, Bart. K. H.—620 pp., with plates and wood-cuts. Philadelphia, 1849: Lea and Blanchard.—This work is a text-book of astronomy, from one of the highest names in the science. It takes up the elements of the science, and leads the student along through the simple principles of motion, refraction, celestial perspective, and terminology relating to our own globe, to the particular survey of the motions of the bodies of the planetary system, comets, planetary perturbations, and sidereal astronomy; and concludes with a chapter on the account of time, and an appendix of four tables, the last of which contains the Elements of Periodical comets at their last appearance.

15. *Patent Office Report for* 1848; 816 pp. 8vo, with plates. Washington, 1849.—The Patent Office Report continues to prove itself a store-house of knowledge on the practical arts. The number of applications for patents during the four years past, exceeds that for the four preceding years by 2,205, the number of caveats by 670, the number of patents granted by 289, the amount of receipts from all sources by $77,284 45, the balance paid into the treasury to the credit of the patent fund, by $21,389 95. Among the patents we observe a fire proof safe with running water as the non-combustible material, to be used when a city is supplied with water by aqueducts—grooved bricks, so made with dovetailed grooves upon their faces that the mortar will lock them effectually together—a varnish of gutta percha and chloroform—a new mode of manufacturing alkaline chromates, by means of the power of a current of steam to take up and carry away the acids of certain salts when brought in contact with them at a strong red heat. The review of patents for the year is followed by a synopsis of the statistical history of the Patent office—a tabular estimate of the crops in 1848; and next detailed observations on the different kinds of products in the several portions of the country, causes of failure or success, with much information on the modes of cultivation and prevention of injuries to crops and domestic animals, including long reports on dairies, sugar cane and its treatment, potato disease, ice trade, U. S. imports and exports of various kinds, and statistics of home trade.

16. *Memorials of John Bartram and Humphrey Marshall, with notices of their Botanical contemporaries;* by WM. DARLINGTON, M.D., LL.D., 586 pp. 8vo, with illustrations.—This work will be gladly welcomed by all interested in the history of American Botany. Bartram was the earliest native American botanist, and the founder of the first Botanical Garden on the continent. His grandfather John Bartram, joined William Penn and removed from England to Pennsylvania in 1682. The botanist was the son of William Bartram, and was born at

Darby, Delaware County, Penn., the 23d of March, 1699. Marshall was born in West Bradford, Chester County, Pennsylvania, in 1722; his mother was a daughter of James Hunt, of Kingsessing, a sister of the mother of Bartram. Bartram lived to the age of 78 years and 6 months, and Marshall to 79 years and 25 days. Our readers might find pleasure in large citations from this elegant volume by Dr. Darlington; but its arrival only at the last moment before closing our number, compels us to give it only a brief notice.

17. *Report on Railroad and Canal Routes between the Atlantic and Pacific Oceans;* by Hon. JOHN A. ROCKWELL. 680 pp. 8vo, with several maps. Report No. 145, made February 20, 1849. House of Representatives, 30th Congress, 2nd Session.—This voluminous document is the result of great research, and embodies a large amount of information upon the resources of the countries through which the proposed routes pass, besides facts bearing upon the feasibility of the courses and plans proposed.

A. LEYMERIE: Du Terrain crétacé de l'Aube, 1 vol. 4to. 2 maps and 18 plates. *Paris.* 18 *fr.*

A. LEYMERIE: Mémoire sur le terrain à nummulites de Corbières et de la montagne Noire, in 4to, with one map and five plates. *Paris.* 7*fr.* 50*c.*

ALBIN GRAS: Description des Mollusques fluviatiles et terrestres de la France, et plus particulièrement de l'Isère, in 8vo. with 6 plates. *Paris.* 5*fr.*

ALBIN GRAS: Description des Oursins fossiles du département de l'Isère, in 8vo. 6 plates. *Paris.* 5*fr.*

J. B. POULET: Mémoire sur quelques Coquilles fossiles nouvelles, découvertes dans la région aquitanique du bassin sous-pyréneén, in 8vo, 6 plates. *Paris,* 4*fr.* 50*c.*

G. P. DESHAYES: Traité élémentaire de conchyliologie, Xe livraison.—This work will form 20 livraisons, in 8vo, constituting 3 vols., of 130 plates.

PLATTNER: On the Blowpipe, edited by Dr. Sheridan Muspratt. 8vo, pp. 432. *London.* 10*s.* 6*d.*

Rev. W. SCORESBY: Zoistic magnetism. 8vo, pp. 144. *London,* 1849. Cloth, 6*s.*

JAHRESBERICHT über die Fortschritte der reinen, pharmaceutischen und technischen Chemie, Physik, Mineralogie und Geologie; unter Mitwirkung von H. Buff, E. Dieffenbach, C. Ettling, F. Knapp, H. Will, F. Zamminer, herausgegeben von Justus Liebig und Hermann Kopp.—For 1847 and 1848.—This is a continuation of Berzelius's Annual of the progress of Chemical Science, published under a new form and plan. The work is issued in parts, and includes notices of all works and articles of the year preceding on the sciences reviewed, and it should be in the hands of every chemist. Parts 1 and 2 have reached us. An English Translation of Part 1, has appeared in London.

E. MILLON ET J. REISET: Annuaire de Chimie, comprenant les applications de cette Science à la Médécine et à la Pharmacie. *Paris.* This annual commenced in 1845. It gives abstracts of the chemical articles of all Journals, and like the annual from Giessen is a work of great value to Chemists. It would seem probable that with a little more effort the authors might succeed in procuring a copy of this Journal for citation, instead of quoting its articles or abstracts of them from reprints in the English Journals.

G. G. PUSCH: Polens Palæontologie, or descriptions and drawings of the fossils of Poland, Volhynia and Carpathia, with 16 lithographic plates in 4to. *Stuttgart.*

BURKHART JOS.: Aufenthalt und Risen in Mexico in den Jahren 1825 bis 1834; containing observations on the surface of the country, its productions, mineralogy, geognosy, mines, meteorology, geography, with an introduction by Prof. J. Nöggerath. 2 vols., with 11 colored plates and sections and charts. *Stuttgart.*

A. MOUSSON: Lie Land-und Süsswasser Mollusken von Java. 4to, iv and 126 pages with 22 lithographic plates. *Zurich.* 1849.

C. MÜLLER: Synopsis muscorum frondosorum omnium hucusque cognitorum. Fasc. 4, gr. 8 (pages 481 to 640.) *Berlin.* 1849.

P. M. Opiz: Herbarium floræ Boëmicæ; viii–ix Hundert. Nr. 422-424 fol. *Prag*, (Kronberger.) 1849.

E. Boissier: Diagnoses plantarum orientalium novarum. Nr. 8–11, gr. 8 (517 pp.) *Paris.* 1849.

Dr. H. Koeler: Einige Beobachtungen über die Temperatur der See-Oberfläche im Nord-Atlant. Meere. Gr. 8 (vi and 81 pp.) *Göttingen.* 1849.

Dr. L. Rabenhorst: Deutchslands Kryptogamen-Flora. gr. 8. xvi and 161 to 352 pp. *Leipzig.* 1848.

Dr. R. A. Philippi: Abbildungen und Beschreibungen neuer oder wenig conchylien. 3d volume, 3d and 4th parts, 60 pp. in 4to, with 12 colored lithographic plates. *Cassel.* 1849.

Proceedings of the American Academy of Arts and Sciences, vol. II,—Nov., 1848. p. 9–61. Conspectus of Crustacea collected on the cruise of the Exploring Expedition; *James D. Dana.*—p. 62–99, Action of water on lead pipe; *E. N. Horsford.*—p. 100, Geological action of Tidal and other Currents; *C. H. Davis.*—p. 101, Tornado of Providence; *U. Parsons.*—*Nov.* 14. p. 105, On the causes of differences of strength in magnets of same size and shape; *Lovering.*—*Jan.* 2, 1849. p. 111, On the planet Metis; *B. A. Gould.*—p. 120, On the law of continuity; *Lovering.*—*Feb.* 6. p. 129, Expansion of Steam in review of a memoir by J. Frost.—p. 130, Rise and fall of waters in Lake Superior; *Foster.*—p. 136, On the satellite of Neptune—Encke's Comet in 1848,—eighth satellite of Saturn—Petersen's Second Comet —Moon culminations observed at Cambridge; *Bond.*—*May* 8. p. 148, Memoir on the Bryology and Hepatacology of United States, presented by *W. S. Sullivant.*—Observations on Medusæ; *Agassiz.*—p. 144, On the Comet now visible; *B. A. Gould.* —*Aug.* 8. p. 159, On Argyroxiphium a genus of Compositæ, and on the new genus Wilkesia; *A. A. Gray.*

Annales des Sciences Naturelles, NOVEMBER, 1848.—Researches on Corals, continued.—Astræidæ; *M. Edwards* and *J. Haime.*—On the Ulmaceæ, continued; *J. E. Planchon.*—DECEMBER. On Corals, continued; *M. Edwards and J. Haime.* —On Annelida; *E. Blanchard.*—On the contractile substance in the lower animals; *A. Ecker.*—On the Ulmaceæ; *J. E. Planchon.*—Cryptogamia of France; *Desmazières.*—On Fucus Wigghii and Atractophora hypnoides; *Crouan.*—Voyage in the Province of Goyaz; *A. de St. Hilaire.*—On some genera of Verbenaceæ; *D. Clos.*—On Calceolaria and Jovellana; *D. Clos.*—JANUARY, 1849. New Experiments on the two movements of the brain; *Flourens.*—On the Development of the Tetrarhynchi; *J. P. Van Beneden.*—On the genus Teredo; *A. de Quatrefages.*—On the antheridia of Ferns; *G. Thuret.*—Conclusions on the vegetation of the Féroe as compared with that of the Shetlands and Iceland; *Ch. Martins.*—On some species of Tribuli; *L. Kralik.*—Sixth century of New cellular Plants; *C. Montagne.*—FEBRUARY. On the Anacharis alsinastrum, and a synopsis of the species of Anacharis and Apalanthus; *J. E. Planchon.*—Monograph of the Podostemaceæ; *Tulasne.*—Development of Ferns; *Leszczyesuminski.*—Ibid; *A. Wigand.*—On the genus Teredo, continued; *A. de Quatrefages.*—Organization of the "Opistobranches," Gasteropodous Mollusca, continued; *E. Blanchard.*—New Hymenoptera of Spain; *L. Dufour.*—New species of Dyctiophora; *L. Dufour.*—On Annelida; *E. Blanchard.*

Archiv für Naturgeschichte, No. V, 1847.—Relations of animals to Endozoa; *Creplin.*—Conspectus of the Crustacea of the Exploring Expedition under C. Wilkes, U.S.N.; *J. D. Dana.*—Review of works on Physiological Botany; *J. Münter.*—No. VI, 1847. Conspectus of Crustacea, continued; *J. D. Dana.*—Ornithological notices; *J. Cabanis.*—Review of works on Botany for 1846; *Münter.*—Ibid on Herpetology, Ichthyology and Mollusca; *Dr. F. H. Troschel.*—Ibid on Geographical Botany; *A. Grisebach.*—No. I, 1848.—On the Egg of Snails; *H. Rathke.*—Observations on the Entozoa, Cysticercus and Echinococcus; *R. Leuckart.*—On new Helminthes; *R. Leuckart.*—Light vessel in Porpita and Velella; *A. Krohn.*—New or little known Annelida; *E. Grube.*—Orchestra euchorus and gryphus, new species; *F. Müller.*—On mode of multiplication in the Chlorogonium euchlorum, *Ehr.*; *J. F. Weisse.*—Species of Ctenomys; *A. Wagner.*—On an original drawing of the Dodo by Roland Savery at Vienna; *L. J. Fitzinger.*—Birds of Upper California; *W. Gambel*, with remarks by *J. Cabanis.*—No. II, 1848. Birds of Upper California; *W. Gambel.*—On the Dodo; *Hamel.*—On the egg of Snails, continued; *H. Rathke.* —Review of works on Ornithology; *G. Hartlaub.*—Review of works on Insects and Crustacea; *Erichson.*

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